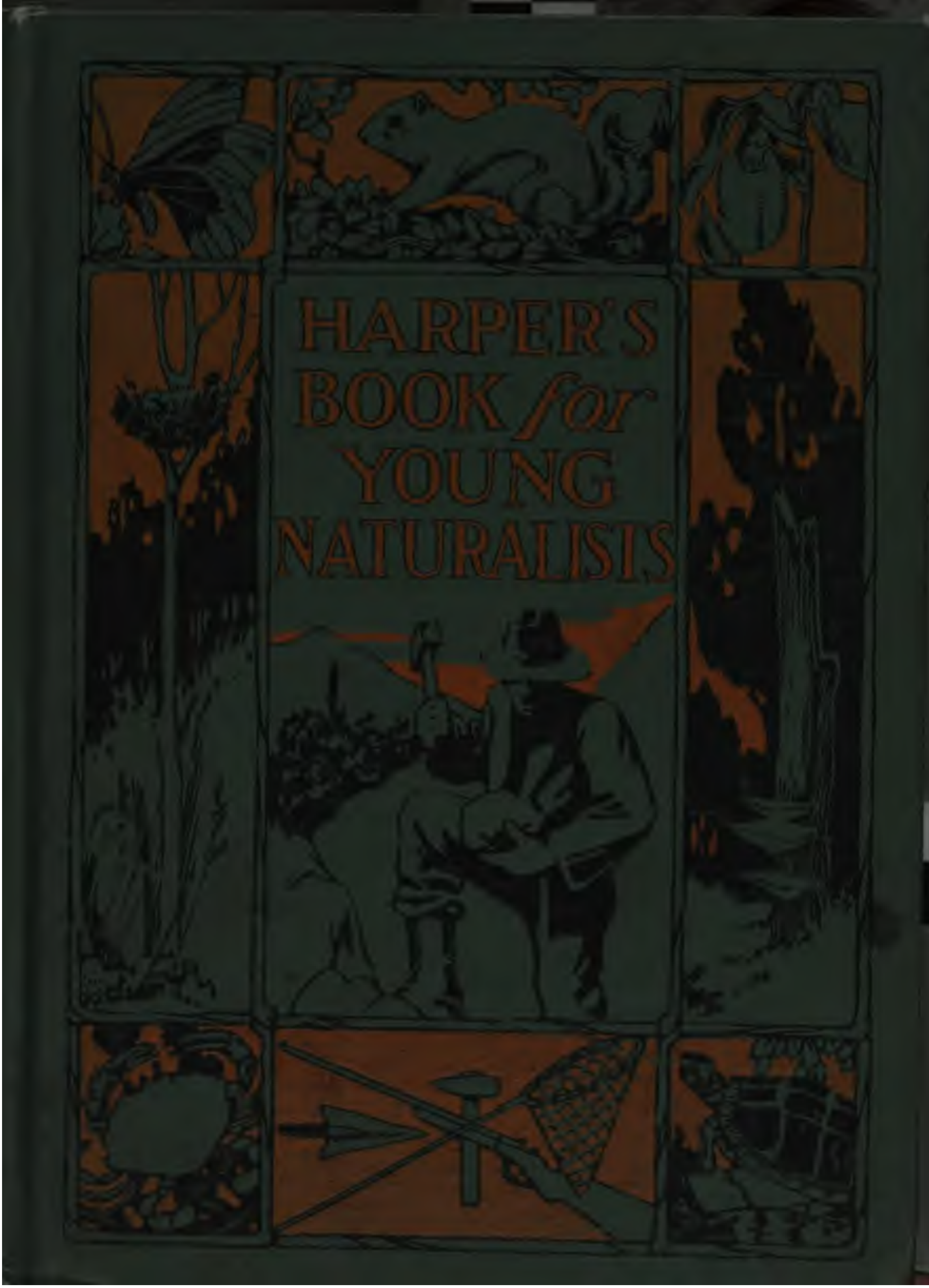
HARPER'S
BOOK for
YOUNG
NATURALISTS

$40 —

(Boys)

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HARPER'S BOOK FOR YOUNG NATURALISTS

A GUIDE TO COLLECTING AND PREPARING SPECIMENS, WITH DESCRIPTIONS OF THE LIFE, HABITS AND HAUNTS OF BIRDS, INSECTS, PLANTS, ETC.

BY
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INTRODUCTION

NEARLY every normal boy possesses an inborn desire to collect something. Whether this tendency finds expression in gathering butterflies, mineral specimens, birds' eggs, or other objects depends largely upon the boy's surroundings and opportunity. There is no question as to the value and interest of collections, if properly made, even of very ordinary things, but in the majority of cases the boys' collections are merely hodge-podge accumulations of trash, and worthless odds and ends gathered here, there, and everywhere without definite object or reason. Such collections are worthless, and merely litter up a home, and prove a nuisance; and it is this class of collecting that has caused many parents to frown on collections of any kind.

Stamps, coins, relics, and antiquities all have their proper place and value, but such things do not necessitate any knowledge of nature or her ways; nor do they take the collector out into highways and byways, to woods and meadows, fields and glades, to seek his specimens. The collection of any class of objects that will get the boy out into the open and close to nature, should be encouraged and commended, and when such collections are made with any sort of system they cannot fail to be of educational value.

Hardly a boy can be found who is not more or less in-

terested in natural history in some form; and with a little guidance and help these boys will make rapid progress in learning more of the ways of wild things, and will form well-arranged and carefully prepared collections of an endless variety of specimens which will be useful, ornamental, and of incalculable educational value. Moreover, the work will keep the young naturalist well employed during his spare hours, and the result of his labor may often prove of real financial value in the end. With the rapid advances of civilization and the building up of rural districts, many of the most interesting and attractive wild flowers, insects, and other wild things are disappearing, and in a comparatively short time it will be impossible to obtain many specimens that are now common. What boy collector of fifty years ago would have dreamed that the worthless "Pied Duck" would ever be worth a thousand dollars, or that a single wild pigeon obtained from the thousands killed and fed to the pigs would sell to-day for three hundred dollars?

This book is written for boys who are interested in out-of-doors life and out-of-doors work, and who are anxious and willing to learn all they can of nature's wonders, animate or inanimate, and who collect or want to collect something of value and interest in an intelligent way.

The author, who has been a professional naturalist and collector for many years, was born and brought up amid collections and naturalists, and from earliest childhood has collected and studied various divisions of animal life as well as minerals, trees, and plants. Although fortunate in having a father who was an eminent scientist and naturalist

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and could help and teach him in his favorite line of work, yet the want of books that would help the young naturalist was often felt.

It is with the object of filling this want in some measure, for the benefit of other boys, that the present book is written, and in its pages the author has endeavored to tell plainly and concisely all about the collection, preparation, and arrangement of nature-study collections suitable for a boy's museum.

In this book the reader will find no dry discussions of genera, families, or species, no long technical terms or names, no theories or suppositions, but merely suggestions, hints and directions from actual experience with here and there interesting and useful facts about the life, habits, or ways of many wild things.

The author believes in boys learning to do things for themselves; and the boy that makes his own cases, his own appliances, and his own preparations will learn more and accomplish more than the one who buys his things ready-made, and in the end he will appreciate his collections far more.

Many seemingly difficult things are very easy when once you know how, and there are many short cuts and handy ways of doing things that are only learned by experience or brought about through necessity. In hunting, exploring, and collecting in out-of-the-way places far from haunts of men, the author has learned and evolved many such "wrinkles," and these, wherever applicable to the subject, have been given in the present volume for the benefit of its readers.

In any book of directions illustrations are a most impor-

tant feature, and "the more pictures and the less text," is a mighty good rule to follow in books for boys.

The illustrations in the present work are all original, and many of the photographs are unique and show the subjects in their natural haunts and attitudes in a most remarkable manner. Where photographs were not obtainable or necessary, drawings have been prepared especially for the work, and these in every case have been made as simple, plain, and self-explanatory as possible.

Finally, the author believes that this book will prove of no little value as an aid in getting together nature-study collections for school use and in fostering and encouraging intelligent and systematic work of this sort among the pupils.

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Part I

THE BOYS' MUSEUM

HARPER'S BOOK FOR YOUNG NATURALISTS

Chapter I

PREPARING THE MUSEUM AND WORKROOM

THE slogan of the Boy Scouts—"Be Prepared"—is a splendid watchword for the young naturalist and collector. Before commencing to collect anything in the way of natural-history specimens you should "*be prepared.*" When on collecting or hunting trips you should also "*be prepared*" to take proper care of any specimen you find, no matter how unexpected it may be; and, finally, just as soon as you reach home with your specimens they should *be prepared*, for nothing is more injurious to good specimens than neglect, and the sooner they are preserved and mounted properly the better and more valuable will be the resulting collection. The most important item for a collector, and one that is very often neglected, is a suitable room or building for a museum or exhibition-room.

Any light, airy, dry room or outbuilding will answer for

this purpose, but all furniture should be removed, the walls, floors, and timbers, if any, painted, and all carpets, rugs, draperies, etc., discarded. The windows should be provided with shades of opaque material to shut out direct sunlight, and if the windows are very large or on the sunny side of the house, cheese-cloth or some similar transparent material should be spread over them. Instead of the cloth the window-panes may be coated with a thin film of whiting and water, but the cloth is more preferable.

Around the walls of the room you should place shelves of varying widths, the lower ones the widest, and, if possible, cases should be built against the walls also. Cases with glass doors are the best, and you can probably manage to get a few of these by using a little ingenuity and trouble. Old window-sash may be used for the fronts, and common pine or spruce boards can be used for the sides, or you can make your own doors and sash and fit panes of glass to them.

If you cannot manage to get or make real wall-cases you can at least make boxes to fit the lower shelves and fit glass covers to these, for your rarest and most fragile specimens.

Minerals, woods, stuffed birds ,and animals, and alcoholic specimens do not require cases, but may be placed on open shelves. If the room is of good size, additional cases should be placed in the center of the room, and these may be either upright cases placed back to back or merely boxes on legs with glass covers. A portion of the room, or an adjoining room or large closet, should be partitioned off and used for a workshop and laboratory. This should be provided with rough benches or tables, shelves, drawers, boxes, etc., and all your supplies, implements, tools, and unprepared speci-

mens should be confined to this room. Nothing detracts more from collections than odds and ends lying about with partly mounted specimens or unclassified things here and there.

It is usually easier and more enjoyable for several boys to combine to start the museum and collections, for each boy usually has some special line in which he is interested or with which he is more or less familiar; and, in addition, it is pleasanter to collect in company than alone, while the collections and specimens will accumulate much faster, and their preparation and care may be divided among several with better results than when one boy attempts to accomplish all the work.

Having selected the boys who are to join in the enterprise, each boy should decide just what he is most interested in, and each should have entire charge of his particular department. These boys are really "curators," and if you cannot find enough boys to give each a particular class of specimens you can give those that co-operate two or more collections each. Any specimens of one thing found by a curator of any other department should be brought in and turned over to the proper curator. In this way much larger and more valuable collections will be obtained than by each boy passing by everything outside his own department, for it is a well-known fact that while you are hunting for one object you will discover many things you are not seeking. The plant-hunter will often find minerals unknown to the mineral collector; the butterfly boy will find birds' nests and reptiles; and the bird collector often finds many rare and interesting insects.

Before any collecting is commenced, however, you should decide just what *to* collect, and what *not* to collect. Many boys collect stamps, coins, postcards, etc., and while these may be interesting and of value to specialists in these lines, yet they have no place in a nature museum. Other boys are fond of gathering large numbers of odds and ends of all sorts; souvenirs, relics, curiosities, and all kinds of trash are collected, but such things usually have little or no value, and are merely gathered together for the sake of "beating the other boy."

The value, both intrinsically and scientifically, of any collection depends largely upon the quality of the specimens, the accuracy of the data and notes accompanying the specimens, and the systematic manner in which the collections are made.

Poor specimens are often excusable, especially if rare; but lack of system or inaccuracy of data is inexcusable, and unless you can make up your minds to do everything thoroughly and to the best of your ability, you might just as well abandon all idea of ever getting a collection or museum that will amount to anything.

Having decided upon the scope of your collections, you can easily divide them into classes or departments, and, as a rule, these will consist of:

Birds, birds' eggs and nests
Insects
Fish, reptiles, and batrachians
Animals, or mammals
Marine invertebrates
Fossils, minerals, and rocks
Indian relics
Plants, flowers, woods, etc.

For each of these departments you must set aside, or reserve, a portion of your museum, for it is very unwise to

mix up different groups; and if one group increases more rapidly than another, you can readily add new shelves or cases or reduce the space allotted to some other group and increase the space for the larger ones. You can judge pretty nearly which groups will require the most and the least space by the part of the country and character of the locality that you live in. If in the interior, you will have very few marine specimens; if in a prairie district, few woods or plants will be found in your collections; and if you live in a mountainous or mining country your minerals will require far more space than they would in the museum of a boy living on the Southwestern plains.

Each department should have labels on the cases or shelves devoted to it, and these should be neatly printed or written on cardboard and tacked securely to the proper case or shelf. The labels may be merely general in character, as "Vertebrates," "Invertebrates," "Insects," etc., or they may be more explanatory and read:

INVERTEBRATES

Marine and Fresh-water Invertebrates

Crustacea, Mollusca, Worms, Radiates, etc.

and in a corresponding way for each group.

Personally, I prefer to have each group or department labeled in a general way, and then the various subdivisions labeled in the particular cases where they are arranged, with individual labels of species, etc., on each specimen.

The principal labels for the cases should also bear the

name of the curator (if any) in charge, for you will find that visitors will always be interested in some particular group, and if they run across odd specimens of the same group they will remember the name of the boy in charge and send him the specimens. Moreover, the boys will take more pride in their collections if their names are connected with their departments.

Besides these general labels for the cases you must print or typewrite a good supply of individual labels for the different specimens. They should be plain and clear, and not over two inches long and an inch wide, and should be arranged as follows:

Common Name............................
Scientific Name............................
Locality....................................
No...............Sex......................
Donor......................................

Each department, or department curator, should also be provided with a blank-book, in which the name, number, sex, locality, and name of donor (the person giving or selling the specimen to the collections) should be written as soon as the specimen is obtained. The date, name of collector, and any remarks in regard to the habits, life, color, etc., should also be carefully recorded in these books. The sex should be indicated by the marks, ♂, for male and ♀ for female. Each curator should keep a separate set of numbers for his own department, and it will then be very easy to

BIRDS						
No	Name	Sex	Locality	Date	Donor	Remarks
166	Barred Owl	♂	Rahway N.J.	Nov. 8 '12	H. Allen	Eyes Black
167	Wood Duck	♂	Cos Cob Ct.	Nov 16 '12	Geo. Birk	Eyes red Bill & legs yellow [illegible] white & yellow
168	Canada Goose	♀	North Carolina	Nov 20 '12	Purchased in market	
169	Mallard Duck	♂	Chesapeake Bay	Dec. 1 '12	Purchased in market	

Fig. 1

WOODS.					
No	Name	Locality	Date	Donor	Remarks
2	Chestnut	Bronx. N.Y.	Nov 30 '12	Curator	From tree at edge of wood
3	Hemlock	Larchmont N.Y.	Nov 31 '12	P. Hubbard	Large tree in deep woods

Fig. 1

keep track of your collections and look up any interesting facts in regard to them, or make new labels when old ones are lost or injured. Fig. 1 shows how leaves of these journals or catalogues appear when properly filled out.

In addition to the records in the catalogues, each speci-

men must be marked with a small, clear number corresponding to that in the books, so that in case of loss of labels the specimen may be readily identified. These specimen numbers may be placed directly on some obscure part of the specimen itself, as in case of woods, minerals, etc., or written on the bottom of the stands of birds and animals. Alcoholic specimens should have the number written on parchment paper with lead-pencil and be placed inside the bottle; and insects mounted on pins should have the number impaled on the pin, close to the lower side of the specimen.

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Chapter II

SUGGESTIONS FOR BOY NATURALISTS

BEFORE actually beginning your collecting you must have everything ready to take care of the specimens. If any of the boy curators have already collected anything, they will no doubt be provided with instruments, tools, and materials for their own use, and these may be devoted to the use of the museum. The insect-curator should have nets, pins, collecting-boxes, breeding-cages, forceps, small and large scissors, cotton batting, wire, a trowel and spade, a rake, an old, stout knife, and sheets of paper and cardboard, besides his mounting-boards, cases, etc.

The curator of each of the other departments should be well provided with the appliances required in his department (as more fully described in the following chapters), but in addition to these department tools there should be saws, planes, hammers, and nails, and other carpenters' tools for the common use of all members, as well as a shelf, or case, of the chemicals, preservatives, etc, required for the preparation of various specimens.

Any two or three boys will usually have all the carpenters'

tools required, and the chemicals, etc., are few and inexpensive. The most important ones are:

Alcohol (denatured or wood alcohol will answer)
Formaldehyde (a quart will do for a long time)
Plaster of Paris
Modeling clay
Motholene or naphthalene flakes
Carbon bisulphide
Corn meal
White shellac
Photographic paste
Glue

Tube oil-colors, dry colors, brushes, turpentine, and many other things may be added as required. All poisons or poisonous things should be kept tightly corked, plainly labeled "POISON" and marked with SKULL AND BONES, and should be kept under lock and key, out of reach.

One source of trouble that you must guard against at all times will be the various museum pests, such as clothes-moths, buffalo-beetles, carpet-beetles, etc. These creatures will appear in a museum almost as soon as the first specimens; and while well-preserved and well-prepared specimens are usually proof against them, yet very frequently some rare or prized specimen will be attacked, and unless given immediate attention will soon be ruined beyond repair.

To prevent these pests from eating up your specimens you should keep all cases and boxes as tight as possible, and place moth-balls or naphthalene flakes in each box, drawer, case, or tray, with the specimens. As long as the museum smells strongly of naphthalene you will be pretty safe, but now and then a specimen may be traded, purchased, or donated which will be already infested. If the feathers or fur rubs or blows off, the entire specimen should be either dipped in gasolene and dried or placed in a tight

box with strong formaline or bisulphide of carbon for several days. This treatment will kill any eggs or larvæ in the specimen, but even after this a careful watch should be kept, and if little piles of dust, dirt, feathers, or fur show beneath a specimen it should at once be treated in the same manner.

Sulphur fumes should never be used, as nearly all specimens will fade if fumigated with sulphur.

Very likely your school-teachers may be interested in your museum, for good collections are of great interest and value in school work, and if they do take up the matter they can help you wonderfully. You will also find that your boy and girl friends, as well as grown-ups, will be interested in your museum, and will constantly bring in new and rare specimens as well as many duplicates and common species. These should never be refused or destroyed, for in the former case the next specimen found may be rare, and, yet thinking it common, the finder may not bring it in, while duplicates are always useful for replacing injured or poor specimens or for exchanging. Specimens common in your vicinity, and easy to obtain, may be very rare or hard to secure in other districts, and such things can be traded, or even sold, to good advantage, thus enabling you to add to the breadth and scope of your collections, or providing a revenue for purchasing new or better appliances and tools or rare and showy specimens from distant localities.

You may think at first that your museum shelves look bare and will be hard to fill, but you will be greatly surprised to find how rapidly they will fill up, and that lack of space will be a greater problem than lack of specimens. No

matter how poor a specimen may be, it should be retained and placed on exhibition until a better one is secured, when it should be replaced by the one in more perfect condition.

Aim to have every exhibition specimen as perfect as possible, and try to keep each group or subgroup as complete as possible. A full series of specimens showing every local species of a family or group is far more interesting and valuable than the same number of specimens from various groups, and as rapidly as one series is completed all your attention may be devoted to others.

Where duplicates show great variation in color, size, or proportions the various specimens should be shown to illustrate the fact, but otherwise a single specimen of each species is sufficient, except in cases where the summer or winter plumages or colors are distinct, or where the male and female are very different in size or color.

Groups showing the male, female, and young are very interesting, and many creatures are so different on two sides that it is advisable to have specimens showing this peculiarity.

Economical and systematical collections are well worth making. An exhibit of some common thing—as cotton, flax, or corn—showing the natural seed or plant and its appearance at various stages of its manufacture, with all the final products obtained from it, are most educational, and never fail to interest visitors. Cereals, woods, fibers, animal products, vegetables, ores, minerals, and many other things can be thus exhibited, and even the collectors themselves will be mightily surprised to find what a fascinating story such economic collections tell.

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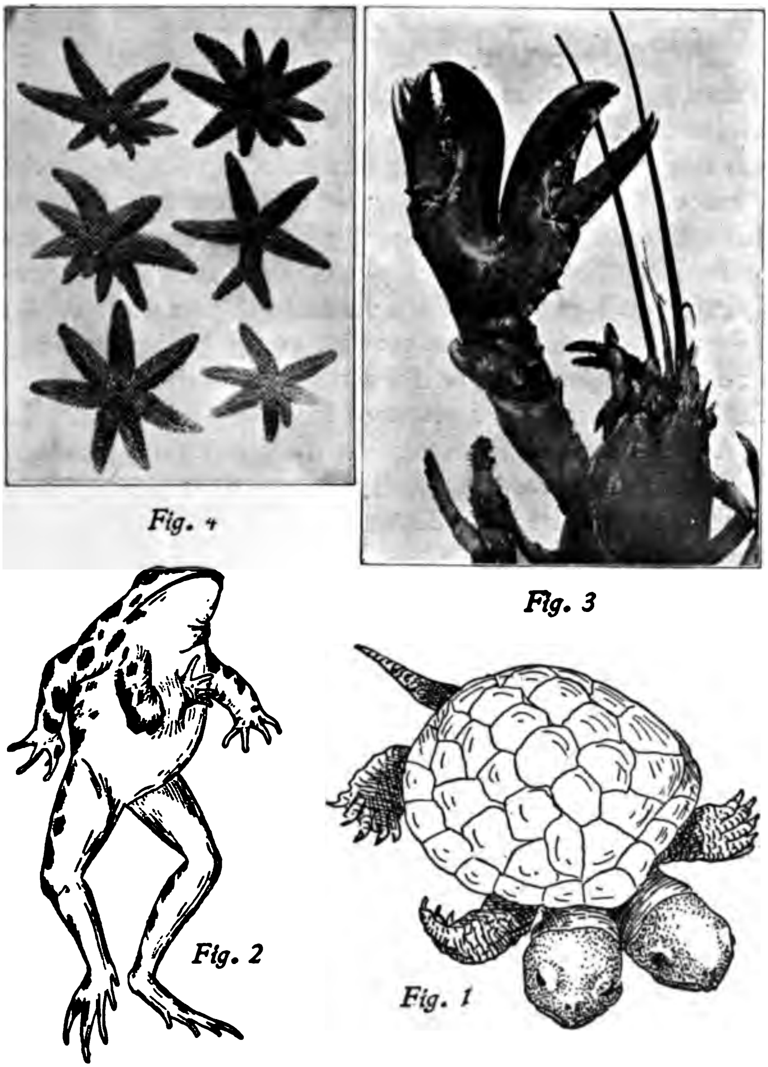

CURIOS WHICH ARE NATURAL FREAKS

Life-history collections are also most interesting and valuable. Such are collections showing the development of insects through eggs, larvæ, pupæ, and imago, or the life story of the common frog illustrated by prepared specimens of the eggs, tadpoles, and adult in different stages, the adult frogs, etc. All these collections are greatly improved by the use of good photographs showing the machinery used in economic or industrial processes, or the general appearance of the growing crops, tilling the fields, and similar operations, or illustrating the native haunts and habits of the creatures prepared for life-history collections.

A great deal of time may be most enjoyably spent in arranging and preparing such exhibits, and, as a rule, the specimens that are best adapted to this class of work are the easiest ones to obtain.

Although curios and antiques really have no place in a museum of this sort, yet certain curios which are natural freaks are very interesting, and a special case should be reserved for them. To this class of specimens belong the white or albino specimens of birds, animals, and insects that are sometimes obtained; double-headed or deformed creatures like the turtle (Fig. 1) or the strange frog (Fig. 2); lobsters or crabs with double or triple claws (Fig. 3); starfish with too many or two few arms (Fig. 4); insects with wings different on two sides; four-legged ducks or chickens; oddly shaped natural growths, and many other most remarkable natural curiosities, including pictures of wonderfully sculptured or worn rocks or cliffs or malformed trees.

Although you cannot collect very many things during the winter months, yet you may spend a great deal of time

SUGGESTIONS

in preparing your museum, labels, cases, and any specimens you may have on hand, while the cold weather is just the season for collecting specimens of woods and minerals, which later on might be neglected, owing to the more attractive things among the birds, plants, and insects.

Chapter III

NAMING AND CLASSIFYING COLLECTIONS

NO matter what branch of nature study you take up, you will soon find that common names are very confusing, for nearly every tree, plant, bird, animal, insect, or reptile has a different name in different parts of the country, and even in one locality the same creature or plant may be known by a dozen or more names. The common yellowhammer, or golden-winged woodpecker, has over fifty common names, and the ruffed grouse may be either a grouse, a partridge, or a pheasant, according to whether he is spoken of in the Northern, middle, or Southern states.

It is for this reason that scientific names have been adopted; and, although at first they seem difficult and hard to remember, it is important to known something about them, and also how to identify any specimen that you are uncertain about. Many popular and scientific books on birds, beasts, plants, and insects are published, and most of these have so many illustrations that common things can be readily identified by a comparison with the cuts. Nearly every library has a number of these books, and it is seldom necessary for a boy to buy one.

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NAMING AND CLASSIFYING

Any boy who takes a real interest in his collections will want to know all he can about them, and will be very glad to study the scientific side of the matter. Do not try to open a strictly scientific text-book or monograph and be able to find anything interesting, for these books are not written for that purpose; and, although interesting paragraphs *do* occur here and there in the driest of these books, yet they are intended for the use of professional scientists and specialists. Much of the matter in these books is absolutely unintelligible to ordinary grown people, and, I really believe, to the writers themselves. Other authors go as far in the opposite direction and tell stories and anecdotes that read like fairy tales, but which do not possess a single sentence or chapter that will tell you to what group or family a certain specimen belongs.

The books that take the middle course, and tell you something of interest with just enough real natural history to teach something, are ones to select, and, fortunately, there are lots of these.

As a rule all living things are divided into *plants* and *animals*. Each of these grand divisions is subdivided into various minor divisions; the first two of the animal kingdom being vertebrates and invertebrates. The first of these includes all creatures having a backbone, while the second includes all that have no backbone.

Each of these two divisions is again divided over and over into orders, families, genera, species, and varieties, and to each is given a Latin scientific name.

The ordinary arrangement of the various divisions of the entire animal world is something as follows:

ANIMAL KINGDOM

BRANCHES, OR SUBKINGDOM

Class	Family
Order	Genus

Species

It would seem as if all creatures could be located somewhere in this list, and assigned to their proper places, but scientists find many intermediate things that they cannot manage to place, and to accommodate these they have created still more divisions as follows:

Kingdom	Superfamily
Branch, or subkingdom	Family
Class	Subfamily
Subclass	Genus
Superorder	Subgenus
Order	Species
Suborder	Subspecies

Varicty

For practical use, however, you do not need to know anything more than the species, genus, and order that your specimens belong in, and even if you know the species and genus you are doing very well.

It is, however, a good plan to know something of the accepted order in which the various groups and classes of animals are arranged; and, as the whole system forms a sort of family tree, it is quite interesting (Fig. 1).

If you can manage to learn, or even write down, the real scientific name of each specimen in your favorite group, it

[redacted]

will be all that is really essential, and this will actually add to the value of your collections, for if you ever wish to exchange or sell your specimens to other collectors they will want to know the scientific names, in order to know what you have. Moreover, many plants and insects, as well as marine animals and minerals, do not have common English names.

The majority of modern popular books on the subject have both English and Latin names given, and in such cases you can readily identify your specimens by the aid of the descriptions or illustrations. When you cannot do this, the best way is to visit some museum or university and look for the specimens similar to yours that you wish to identify.

Some groups are much easier to learn than others, for the numbers and va-

Fig. 1

rieties are less numerous. Thus birds and mammals are comparatively few in species and genera, while insects are very numerous, as are plants and marine invertebrates. For this reason most naturalists who make a study of insects or invertebrates select a special group, such as beetles or butterflies, and collect and study these to the exclusion of all others, for with the enormous number of insects now known it is practically impossible for a single man to make a thorough study of the whole insect kingdom. The boys who establish their museum and its collections need not be troubled over this matter, for no two scientists agree, anyhow; and if you learn the life and ways, the strange habits, the wonderful intelligence, and the surprising beauty of wild things, it will be worth more than all the dull scientific theories in the world, and the fact that the collection and preservation of your specimens takes you out into fields and woods and gives you health and strength is of more real worth than degrees and titles.

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Part II

BIRDS, BIRDS' NESTS, AND BIRDS' EGGS

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Chapter IV

SHALL WE COLLECT BIRDS?

WHETHER or not to collect birds, birds' eggs and nests is a very important question for many people, as the Audubon societies and other bird-protectionists do not approve of killing any birds whatever, and consider taking birds' eggs as a serious crime.

I certainly do not advise or approve killing song or insectivorous birds or destroying their eggs needlessly or recklessly, but Audubon himself found it necessary to destroy bird life to a certain extent in order to study birds and make his drawings, and I cannot see any valid reason why any boy student or naturalist should not be permitted to kill any birds or take any eggs that he really wants for serious study or for a systematic collection.

As a matter of fact, I do not believe that all the birds ever killed or eggs taken by boys for their collections have made any appreciable difference in the numbers of our useful birds. A single house-cat will destroy more bird life in a week than the most heartless boy could possibly destroy in a year, and yet practically no effort has been made to do

away with cats, or to muzzle them in such a way that they cannot kill birds.

Many leaders of Audubon and similar societies collected birds and eggs in their youthful days, and many still collect, and all they know about the birds was learned in this way. Killing several birds of a kind or taking a number of sets of eggs for a "series" is uncalled for, and should be discouraged; but a single bird of a species, with a single nest and eggs, makes a most valuable and interesting collection. Moreover, a great many of our birds are neither song, insectivorous, nor really useful species, and there certainly can be no possible objection to collecting game-birds, birds of prey, and water-fowl, and these alone will make a very creditable collection. The value of bird study cannot be too highly estimated, for the economic value of our birds is very great, and upon their presence or absence depends largely the success or failure of crops, for man unaided by birds can accomplish but little in keeping insect enemies in check. Of course, birds can be studied and watched, and a great deal of value and interest in regard to their habits, life, and food may be learned in this way, and the young bird-collector should make the study of live birds as much a part of his work as the collection and preparation of specimens.

Many birds live in one locality the year round, while other species travel back and forth across the country at certain seasons. The latter are known as migratory birds, and observations in regard to the dates on which they arrive and depart, with notes on their numbers, are very valuable and interesting. Some of these migratory birds

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breed in the far north and winter in the south, and in going to and from their breeding-grounds travel vast distances. Some species that spend the summer within the arctic circle spend their winters in the Antarctic, while others travel comparatively short distances.

Other species live in the far north throughout the year, and only appear in temperate countries when driven south by extreme cold or lack of food. Still other species, that are really tropical birds, occasionally wander north during the summer months and appear at rare intervals in localities hundreds or thousands of miles from their native haunts. To collect such stragglers can do no possible harm, for only by actually obtaining the specimen can you establish a bonafide record of the species' presence; and, as these solitary wanderers would perish miserably of cold and hunger at the approach of winter, their collection entails no loss, and is really an act of mercy. Many birds have very different plumages at different seasons, and where possible a specimen in each plumage should be obtained. Many of the ducks, waders, and other water-birds are remarkable for this variation in color (Fig. 1); and, as these are annually killed in large numbers for mere "sport," the boy naturalist need not hesitate to take what he requires for his museum.

Other birds are really injurious or harmful, as they kill or devour really useful birds, while other species are neither really useful nor actually harmful, and any such species can be collected without fear of doing any harm to the farmer or his crops. A great many common birds have the male and female so distinct in color that they appear like different species, and are actually called by different names in some

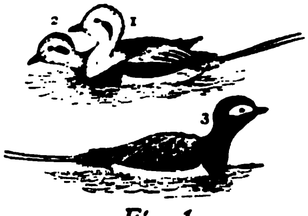

Fig. 1

1 and 2—Male and female in winter.
3—Male in summer.

Fig. 3

Fig. 2

localities. If such species are included in the collection, a specimen of each sex should be obtained to illustrate this peculiarity (Fig. 2).

Birds should *never* be killed during the breeding-season, as in that case young birds may be left to starve or eggs may be destroyed without the least benefit to science. Early in the spring migratory birds may be collected, and late in the summer or early in the fall other migrants, as well as adult residents that have already reared their families, may be obtained. Game-birds should, of course, be collected during the open season; while birds of prey, as a rule, breed

Fig. 4

YOUNG HAWKS

very early in the spring, and may be collected all through the summer, fall, and winter.

If you or your parents do not approve of collecting or killing birds for the museum, you can use photographs of live birds or accurate colored prints instead, and if these are exhibited with the real nests or eggs they will be very interesting, and will answer very well in place of actual specimens of the birds themselves (Fig. 3).

Photographs are particularly valuable in illustrating the appearance of young birds, either in the nest or after they are quite well grown. Many young birds are very odd and interesting creatures, and only slightly resemble the adults of the same species. You would scarcely imagine that the long-necked, down-covered, ungainly creatures shown in Fig. 4 were young hawks, and that they would grow into glossy-feathered, keen-eyed marauders in a few weeks.

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Chapter V

BIRD TAXIDERMY

BEFORE commencing to collect birds you must learn to skin and stuff them, and for this purpose you should obtain birds that are of fairly good size, and either really harmful or useless species should be killed as subjects on which to practise taxidermy.

Bird taxidermy as practised by professional taxidermists and museums is a difficult and complicated art that requires great skill in modeling and casting, a knowledge of anatomy, and familiarity with the lives and habits of the creatures to be prepared.

Very good specimens can, however, be prepared by the old-fashioned and simple methods, and will serve for all practical purposes. The results, with a little practice, will prove most gratifying to the boy taxidermist and his friends. Although an expert can do very good work with only a few simple tools, and can skin birds with no other implement than a penknife, yet the beginner will find the following invaluable in his work: two old tooth-brushes, one stiff, the other soft; one three-cornered or flat file; thread and needles; paper of long pins.

Of course, the first step in preparing to mount birds is to

have the proper tools. One pair cutting pliers; one pair flat-nose pliers; one pair round-nose pliers; one small, one medium, and one large scalpel; one pair small surgeon's scissors; one pair common scissors; one pair small and one pair large forceps (flat points); one pound arsenic or one bottle arsenical soap; one cup; excelsior; cotton batting (the best obtainable); some fine tow; soft annealed iron wire, Nos. 23, 20, 18, 16, 14, 12; assorted glass eyes, Nos. 2 to 8 black, and Nos. 6 to 15 yellow, brown, red, and hazel.

The total cost of above will be about five dollars, and the articles may be purchased from any dealer in taxidermists' supplies. Of course, you need not buy all at once, for if you stuff small birds only the smaller-sized tools, wire, and eyes will be required; or you can wait until the birds are finished before buying eyes, and then only order those actually needed at the time.

As soon as your bird is killed stuff a little cotton down his throat and in his nostrils, and scatter Indian meal (the white is best) on any blood you notice, rubbing it gently among the feathers and brushing it off and dusting with fresh meal as fast as the blood is absorbed. Then drop the specimen head first into a paper cone and carry him as carefully as possible. When ready to skin the specimen, remove the old cotton from bill and nostrils with the forceps, and replace it with fresh cotton. Dust off the bloody meal, and wash the spot thoroughly with a small sponge, tuft of cotton, and warm water. Brush the wet spot with meal and a tooth-brush, using plenty of meal, until dry. If the blood still shows, repeat the washing and drying process until no trace of the spot remains and the feathers lie evenly

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and smoothly in place. In the case of birds with dense white feathers, such as shore and sea birds, it is often necessary to use plaster of Paris in place of the meal, and when thoroughly dry and clean remove all traces of plaster by brushing with meal and beating gently but thoroughly with a light switch or whalebone.

Now lay the bird on a table with bill toward you and separate the feathers along the breast and abdomen. Make an incision from the middle of breast-bone to the vent, being careful to cut through the skin only, and not through the flesh and abdominal wall also (Fig. 1, AB). Lift up one edge of the skin with the forceps, and separate it slowly and carefully from the meat with the end of the scalpel handle. If the skin adheres firmly to the flesh, cut through the fibers with scalpel, but be careful not to cut the skin or to pull too

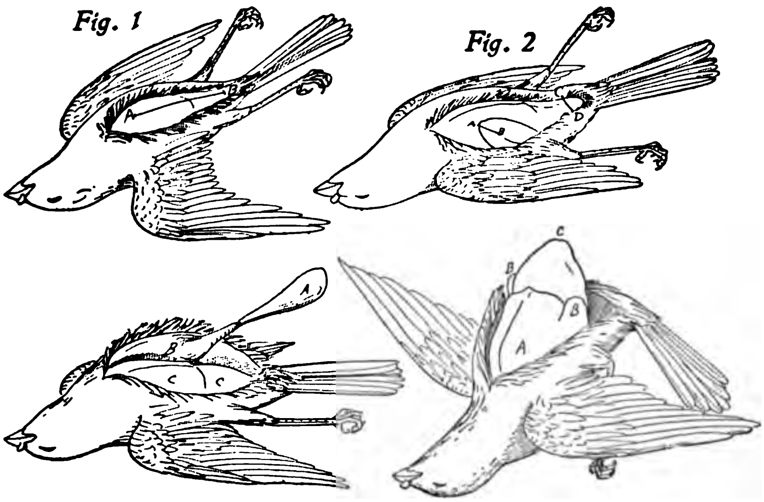

Fig. 1 Fig. 2 Fig. 3 Fig. 4

hard and tear it. Scatter meal upon the flesh and skin as you proceed, to prevent the feathers from getting dirty, and work the skin off gradually toward the side and downward along the abdomen. Work first on one side and then the other until the thigh of the leg is reached. Grasp the leg outside the skin and push it slowly and firmly toward the breast until the knee, or first joint, is exposed (Fig. 2, A). With your scalpel and scissors cut through the joint (AB) and work the skin away around it, pushing it upward from the outside and pressing back the skin from inside until the slender, almost bare bone at the outside joint is reached (Fig. 3, AB). Cut all tendons and cords at this point, remove the flesh, and wrap a bit of cotton about the bone. Then pull the leg back from outside and proceed with the other leg in the same manner. You may now work slowly toward the tail until the base of the latter is reached. Cut through the flesh and small bone at base of tail (Fig. 2, CD) (being very careful not to go too far and cut the quills), and, bringing the body of the bird into a partially upright position (with tail upward) (Fig. 4), proceed to push the skin from the body up the back. If you work properly you will find that the skin turns partially wrong side out as you work, and presently you will reach the base of the wings. Cut through the wings close to the body, and leave them for the present. You will now reach the base of neck, and by holding the body up the partially separated skin will fall down over the neck and head. Pull the skin carefully off the neck, being careful not to tear it, and turning it off like the finger of a glove, until the base of skull is reached. Lay the body on the table

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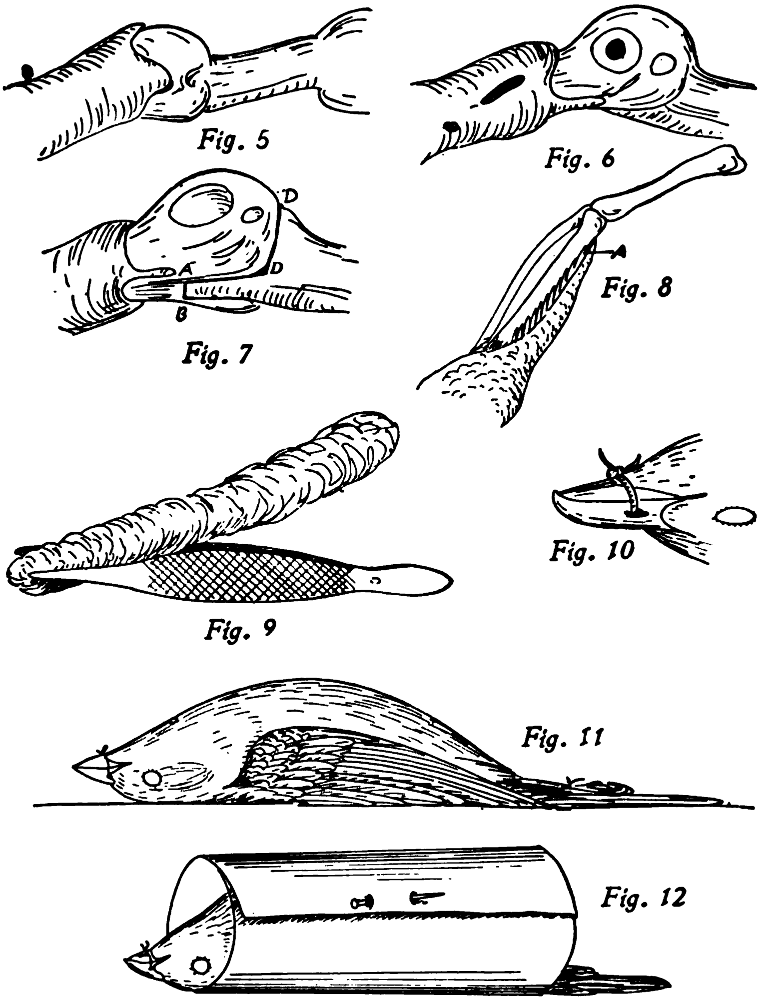

MAKING A BIRD SKIN

and carefully work the skin off over the skull (still turning it like a glove finger) until the ears are seen (Fig. 5). Be very careful here and lift out the membrane that lines the ear with the forceps. You will probably spoil several specimens before you learn just the right way to remove the ear, but it is an art that cannot be well described in print, and practice is required to do it properly. Work carefully and slowly, coaxing the skin away a little at a time, and you will presently see the eyes. Push the skin gently across the eye until the eyelids adhering to the eye prevent further progress. Now with your small scalpel make a careful cut across the lid against the eyeball, but not cutting through more than the lid, and you will find that the eyelid slips off readily. Proceed on the other eye, and push the skin from skull to base of bill (Fig. 6). Remove the eyes by pushing your forceps beneath and behind them and lifting them from the sockets entire. Turn the skull (with skin attached) bottom up, and push the point of your fine scissors down between the jaws of the bird a little in front of the eyes (Fig. 7, AB), and cut through the tongue, throat, and roof of mouth. Then make a lengthwise cut close to inside of jaw-bones on each side of mouth, and reaching from the first transverse cut back to base of skull (Fig. 7, AD and BD). Connect these two cuts with another cross-cut in base of skull a little above where neck joins the skull (Fig. 7, DD), and the meat and greater portion of brains will come away from skull when neck is pulled gently. Remove all brains, meat, and fat from the skull, and lay the body and neck aside for future reference.

Now take hold of the base of one wing and press the skin

away from the meat until the first joint is reached. Take hold of wing outside of skin and proceed to skin it much as you did the legs, but as soon as the bases of large feathers are seen work with great care and push the skin from the bone on the side on which there are no quills, leaving the quills adhering to the bone (Fig. 8, A). Scrape and cut off all the flesh and remove the inner loose joint of bone. Now clean off any bits of flesh, grease, or fat around base of tail, and brush entire inside of skin, head, and wings with arsenical soap or dry arsenic mixed to a thick paste with water. Pull the wings back into place, and reach up among the feathers of neck until you can grasp the bill with forceps or fingers. Pull the bill gently out—holding the bill meanwhile, and pushing the skin of neck back over skull from inside, and thus work the head and neck right side out again. When this is done brush and smooth all feathers into position. Remove old cotton from bill and nostrils, wash any spots of grease or blood on plumage, and clean and dry with meal. Push the leg-bones up until the cotton can be removed; brush bones and skin of legs with arsenic; wrap with fresh cotton, and pull back into position. Make a little wad of cotton, and insert it through bill into eye socket, arranging eyelids in a natural position, and equally distant from base of bill and top of head on each side. Lay the skin back down on table with opening in breast wide open and neck stretched straight out. Make a slender roll of cotton about the diameter of real neck and about half as long. Grasp this at one end with your forceps (Fig. 9), and work it up through skin of neck until points of forceps and cotton are visible through open bill. Hold the pro-

truding end of the cotton outside the bill, and draw forceps back from neck, leaving the cotton neck in place. Arrange the feathers of head and neck smoothly and naturally, and tie bill together with a bit of thread through nostrils and around lower mandible (Fig. 10). Make a little bunch of cotton, something the shape of body and a trifle smaller. Place this inside the skin well up toward the neck. Draw sides of skin together and sew them with a few stitches of thread. Turn the specimen on its side, and arrange wing so that feathers lie as in life and there is no unsightly hollow or bare space at shoulder. Repeat this with the other wing, and turn the bird skin gently back, with belly up. Smooth and arrange all feathers; cross legs near feet and tie with a piece of thread; and if you are making a collection of bird skins, tie a neat label on the crossed legs. The label should give name of specimen, number in the collection, sex, date, locality, length from tip of bill to tip of tail (these to be taken before bird is skinned), color of legs, eyes, and bill, and any other notes of interest. When the feathers are all smooth and in place, and the cotton-filled skin looks like a freshly killed bird lying on the table (Fig. 11), make a smooth paper cylinder as long as the bird, and the same diameter as the real body. Place this cylinder on the table with one side just under the bird's bill. Push the bird slowly and carefully into the cylinder of paper until bill reaches further end (Fig. 12). Glance into the cylinder, and if bill is to one side or crooked, arrange it evenly with forceps; do the same with tail and legs, and place cylinder containing the bird in a safe place to remain undisturbed until thoroughly dry. In the case of a small bird this will require about a week.

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Larger birds will take much longer. This will be a scientific or study skin such as are made by field collectors, and form the bulk of all museum collections and private collections. They occupy less room, are more easily cared for, and in many ways are more valuable than mounted birds, and the young taxidermist should always learn to make a first-class skin before attempting mounting. The best-sized bird to start on is a robin, yellowhammer, bluejay, blackbird, or some other bird of about their size with smooth plumage and tough skin.

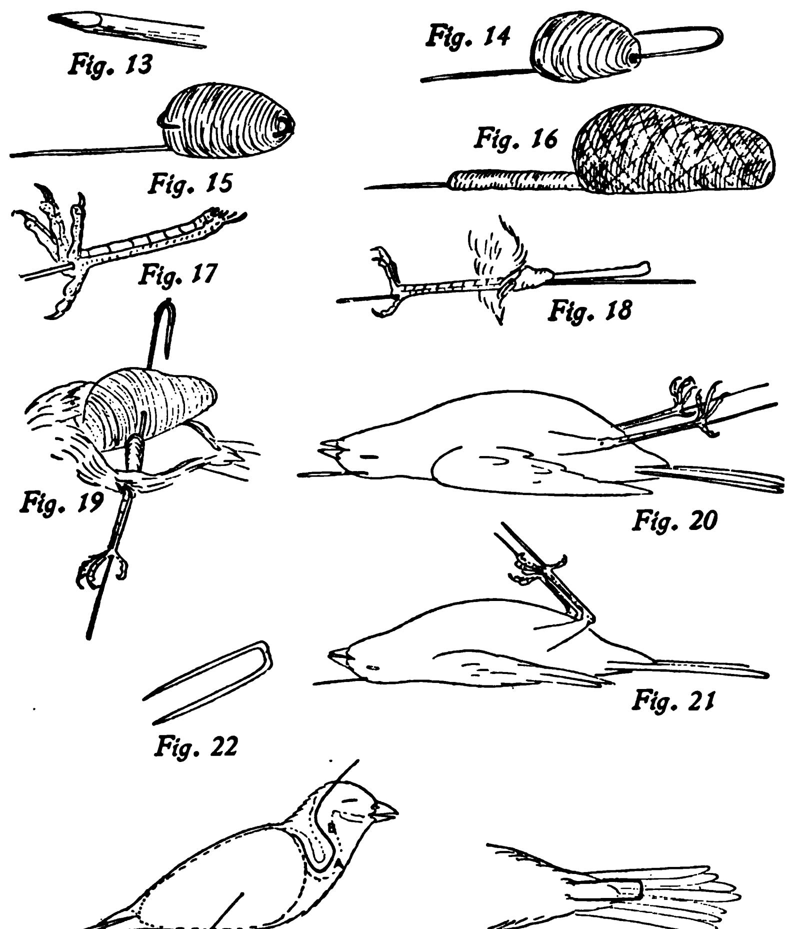
Study-skins, as made by the above directions, are the best form in which to preserve large collections or collections made at some distance from home, but for exhibition purposes or groups the birds must be "set up" or "mounted."

Having skinned the bird, which we will assume is a robin, bluejay, or bird of similar size, we will proceed to mount it.

Select a piece of wire of the right size, about No. 14 for a bluejay, cut off about eight feet, and fasten one end securely to a nail or some other strong fastening. Seize the other end in the pliers and pull strongly and steadily until you feel the wire stretch slightly. This will make the wire perfectly straight, which is an important matter. From this straight wire cut a number of pieces, each about twice as long as the entire length of neck and body which has been removed from the bird skin. Cut the pieces diagonally with your cutting-pliers, and lay them side by side. Sharpen both ends of one piece and one end of each of the other pieces with your file, which is readily done by placing the end of wire on a table or piece of board and pushing the file toward the end on the edges of the diagonal cut (Fig. 13). Now

take a bunch of fine excelsior and gather it into a rough ball about the size of the bird's body. Wrap it closely together with strong thread until about half the size of body. Take the piece of wire sharpened at both ends and thrust it through the ball of excelsior near one side. Allow one end to project about twice as far as the length of the excelsior ball. Bend this over sharply (Fig. 14). Thrust the bent end back through the excelsior and clench (Fig. 15). Now take small wisps of excelsior and wrap them on to this, gradually building up the rough ball until it is firm and hard, and as near the shape of the real body as possible, but a trifle shorter and smaller all round. When this is accomplished wrap some fine tow or smooth cotton around the projecting wire until it is the diameter of the bird's real neck but not quite as long. The artificial body and neck should now appear like Fig. 16. Take the skin and turn back feathers and skin until the base of skull is exposed, run the wire of artificial neck up through the top of skull until the cotton or tow is against the skull. Turn down the skin over neck and body, working it gently and carefully, and taking care that no wrinkles remain and that body is straight in the skin. If the two sides of the skin meet readily over the breast, the body is the right size. If they lap over and are loose, the body is too small. If they do not meet readily, and tail will not come up over posterior portion of the excelsior body, your body is too large. In either case you can easily remedy the trouble by turning the skin back and trimming off or adding on excelsior until it is just right.

Now turn back the legs exactly as you did in skinning the bird, and, holding the outside part in your left hand with



FIRST STEPS IN MOUNTING A BIRD

foot toward you, insert the sharpened end of one of your wires in the sole of the foot at base of hind toe (Fig. 17). Run the wire steadily up along the back side of leg between skin and bone, hold the knee straight, and continue pushing up the wire until it shows on the inside of skin where turned back, and pull it up from inside for several inches (Fig. 18). Tie it to the thigh-bone, and wrap a little fine tow or cotton around both bone and wire. Turn the leg back in place and insert sharpened end of wire in side of excelsior body as near the spot where real leg was cut as possible. Push the wire through the body until it projects an inch or two, bend end over (Fig. 19); pull it back through body and clench it. While doing this you must take care that you do not tear the skin of leg or body, but keep sliding the leg up or down wire as may be necessary to give plenty of room. Proceed in the same way with the other leg, and then slide both legs up on wires until the artificial thighs touch the sides of body. Be careful that skin of body is not caught between thighs and excelsior body, and when this is attended to draw skin together over belly and stitch together with thread and needle. Now bend both legs upward until the thighs are parallel with body, being sure the bend is at spot where thighs join body, and not between body and knees. The bird will now appear as in Fig. 20. Now bend legs slightly at knees (Fig. 21). Take a small piece of wire sharpened at both ends and form it into a staple Fig. 22, and push this through base of tail on under side into body (Fig. 23). Now bend the neck downward against breast and then backward in a sort of S-shape (Fig. 24, AB). Select the perch or stand on which to mount your specimen, and bore two

holes through it about as far apart as width of bird's body. Run the wires projecting from feet through these holes and wrap them several times around the perch. See that toes are properly arranged with three in front and one behind (in the case of woodpeckers, whippoorwills, nighthawks, kingfishers, and owls two toes on each side), and press knees slightly together to avoid bowlegs (Fig. 25). Next bend legs backward and body forward until a natural balance and position of legs is obtained, and if possible turn the body a little to one side on the legs, to give a more lifelike attitude. If one foot is a little higher on the branch than the other it will be better also. Then lift wings and hold against sides until the feathers on shoulders fall smoothly into place. When this is done pin them in place with a piece of sharpened wire or a long insect-pin, leaving the outer end projecting an inch or so. In pinning the wings be careful to run wire through the shoulder and not between the quills. Place another wire under the middle of wing on each side, and be sure that wings are equally high and that tips are even on both sides (Fig. 26). Now bend neck and turn head until a lifelike attitude is obtained, with neck not too long or too short, and stuff little wisps of cotton into neck, throat, and skull through bill until the head and cheeks are rounded out naturally, but do not make your bird's head look as if it had the mumps. Place a little wad of cotton in each eye, and fill out throat plump and smooth. Select a pair of eyes the color of the natural eyes, and just large enough to fill out the eyelids by slipping under the lids, but not so large as to stretch the lids and bulge, and yet large enough so they will not drop out. Arrange the lids smoothly over

eyes with fine forceps. See that both eyes are equally spaced from bill and top of head, and that neither one projects out from head farther than the other. You will require practice to accomplish the eye-setting nicely, but by working from the outside with forceps and pressing outward from the inside of head through the mouth you will soon get the hang of it. When eyes are properly arranged, tie the bill together exactly as described in the directions for making a skin, and then go over your whole bird and smooth and arrange the feathers with forceps and your fingers until they all lie naturally in place. Spread the tail slightly, and hold in position by two strips of stiff paper or thin cardboard placed above and below and pinned together (Fig. 27). Now take some fine soft yarn or the thread from one of the cops (conical balls of soft thread sold by all dealers in taxidermists' supplies), and fasten one end of the thread to one of the projecting wires of wings. Commencing here, wind your bird carefully around and around from one wire to another, using little pressure, but adjusting the pressure so that all feathers are kept smooth and even. This winding requires practice in order not to cause ridges and lumps, but after a time one becomes very expert in doing it. Your bird will now appear like Fig. 28, and should be placed in a dry spot for a week or two to dry. When thoroughly dry, cut through the threads with sharp scissors, cut off all projecting wires with cutting-pliers, and decorate the stand to suit yourself, and the bird is finished. If you wish to mount the bird with wings spread, they must be wired in the same way as the legs (but before the legs are wired), and the feathers spread by bending the wires in the natural position

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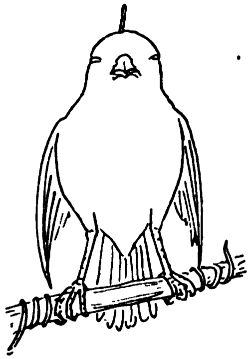

Fig. 25

Fig. 26

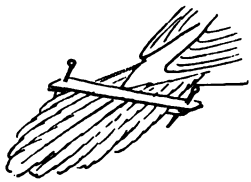

Fig. 27

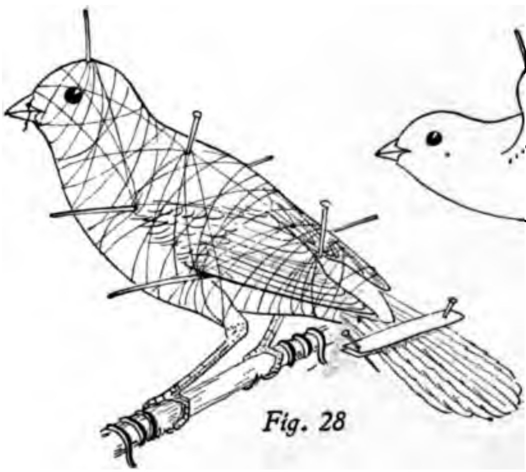

Fig. 28

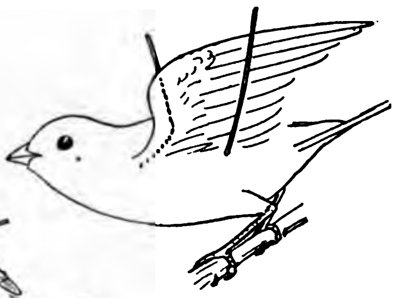

Fig. 29

FINAL STEPS IN MOUNTING A BIRD

of a bird's bones when his wings are spread. The feathers are held in place by wires stuck through the body, one end clenched and with the other end projecting out under center of wings to support the feathers like a shelf (Fig. 29).

The above directions for skinning birds refer only to the common birds, but the young taxidermist may meet with some species which require special treatment. Many ducks, woodpeckers, etc., have heads so large that they cannot be turned through the neck. In such cases skin to base of skull. Cut off neck, and turn skin back into place. Make an incision through skin along back of neck from base of skull for an inch or two down the neck, and turn skull through this opening. In the case of certain sea-birds, herons, hawks, etc., the wings cannot be skinned from inside, and must be skinned as far as possible and then the remaining meat removed by making a cut from outside through skin along the bones on under side of wings. Many large birds, such as the long-legged herons, ibises, cranes, etc., should have the large tendons removed from legs. This is done by cutting a cross-shaped place in sole of foot. Through this the tendons are severed, and if the ends are grasped with pliers they may be pulled out of leg readily. This should be done after the legs are skinned as directed. If your birds are very fat or greasy, as in the case of ducks, geese, shore-birds, etc., the fat should be thoroughly removed by scraping and rubbing with corn meal and plaster of Paris. Grease spots on feathers are removed by gasolene or benzine and corn meal.

Dried study-skins may be mounted at any time by softening them by placing in damp cloths overnight. Then

remove all the cotton stuffing and replace with cotton wet but not dripping. Wrap all in damp rags again, and when thoroughly soft and pliable proceed as with a fresh skin. The feathers will look bedraggled, wet, and discolored, but do not let that worry you. They will all dry out while you are working at the skin.

Chapter VI

EXHIBITING AND MOUNTING BIRDS

YOU must not expect to turn out a really well-mounted bird the first time you try, for even to make a good, smooth, well-proportioned skin requires practice. It is merely a question of "try, try again," however, and after a few attempts you will get the knack of the work, and will soon be able to mount birds that really look lifelike. Until this is accomplished you should not start to collect for your museum, and no poorly mounted or unnatural-looking specimen should ever be placed on exhibition. Many large museums actually have specimens of mounted birds that are really monstrosities and are a disgrace to the cases, and give observers a very wrong idea of what the real bird looks like.

Close observation of living birds and a study of photographs and good drawings will teach you the attitudes and pose of birds, and when in doubt you should visit some good museum and carefully sketch the positions of the splendidly mounted groups of birds that these institutions have on exhibition. Menageries and zoological gardens are also fine places in which to watch the birds and study their attitudes, and you should aim to reproduce the most charac-

teristic position in your stuffed specimen, and not attempt to mount a bird either in flight or in some strained or peculiar attitude even if such a pose is perfectly natural. Many wild birds constantly assume positions that would appear ridiculous in a mounted specimen of the same species, for you *know* the live bird is natural, but a stuffed dummy is a very different matter, and nine times out of ten people will laugh at it and question the possibility of a live bird ever getting into such a pose.

As far as consistent with good mounting and natural position, birds should be arranged to show the peculiarities of markings, colors, or plumage to the best advantage, and if one side of the bird is more perfect than the other the best side should be placed toward the front of the case, and your best work devoted to that side (Fig. 1). Sometimes a rare or handsome specimen is badly shot or torn or otherwise so mutilated or so stained that it seems useless to try to transform it into a respectable specimen, but with a little forethought and ingenuity these bad specimens may usually be worked up into a group or mounted in such a way that the perfect parts are shown without any indication of the injured portions.

A duck with legs completely shot off may be mounted on artificial water in a swimming position, or a woodpecker minus a tail may be mounted peering from a hole or peeking around a tree-trunk that conceals all but the fore part of his body. Injuries to beaks may be filled up with modeling-wax or putty, and colored, and will scarcely be visible. Tail or wing feathers that fall out or are pulled out should be preserved and set into place with a little glue or shellac.

Of course, it hardly pays to try to preserve badly injured specimens of very common birds or game-birds, but the taxidermist will find a great deal of pride in specimens res-

Fig. 2

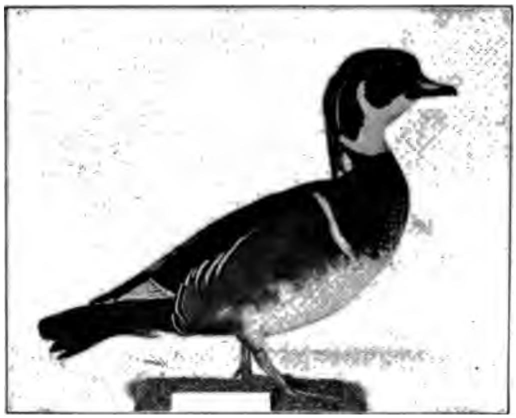

Fig. 1

cued from the rubbish pile by skilful work and patience, and work of this sort is mighty good practice.

A few years ago all the leading museums and collectors mounted their birds on stiff, painted stands or perches, but now the aim of all taxidermists and museums is to make their specimens look as lifelike as possible, and to arrange them in groups amid natural surroundings and accessories in such a way as to show at a glance something of their habits, food, or life.

The boys who have plenty of space at their disposal can make up very interesting groups illustrating the old birds

with nest and eggs in an exact reproduction of the spot where found. Other groups, showing birds feeding, are interesting, as such groups can be arranged to illustrate the economic value of the birds — sandpipers on the edge of water, birds eating fruit, sparrows feeding on weed seeds, and many similar groups will be both attractive and educational.

All these groups require a great deal of time to prepare, and occupy a good deal of space which can often be used for other things, and where the amount of room is limited it is advisable to mount your birds, singly or in pairs, on natural twigs and branches, stumps, artificial rocks, etc., and these will serve every purpose for the museum (Fig. 2).

Specimens of birds, whether in the form of study-skins or mounted, should be most carefully labeled, for many times the value of a specimen depends very largely upon the accuracy and details of the label or data-blank.

The date of collecting, name, locality, number, sex, length from tip of tail to tip of bill in freshly killed bird, length of wing along outer edge from shoulder to tip of longest feather, and spread of outstretched wings are the most important items, but notes on the color of eyes, color of feet, legs, and bill, and circumstances under which the bird was collected are all very useful.

Blanks with spaces for these various items should be printed or purchased, and each specimen should have a label properly filled out attached to it, or should be numbered to correspond to the label properly filled and kept on file.

A very good form of label to use is as follows:

No. . . . . Sex. . . . .

Common Name. . . . .

Scientific Name. . . . .

Locality. . . . .

Collector. . . . .

Date. . . . .

Wing. . . . . . . Length. . . . . Extent. . . . .

Eyes. . . . . Bill. . . . .

Feet and Legs. . . . .

Many of your bird specimens will no doubt be obtained from hunters and friends who shoot them while hunting, while many birds of prey may be secured from farmers, who, as a rule, kill every hawk or owl they see within gunshot, and are very willing to turn them over to boys who want them.

Such specimens are often badly torn and very bloody or dirty, but when shooting specimens yourself you should take every precaution to injure the specimens as little as possible, and to keep them clean and free from blood. Small birds should be killed with dust-shot or No. 12 shot; and one dram of black powder with the same bulk of shot, and lightly loaded with a single wad over the powder, and another over the shot, will prove very satisfactory, and will kill birds as large as bluejays and yellowhammers, and will scarcely leave a mark on the smallest warbler.

Many of the larger birds of prey may be successfully

trapped by placing a steel trap on top of a stub, fence-post, or rock where the birds are in the habit of alighting, and in open country such spots are so few and far apart that a bird is almost certain to be caught. Traps baited with a dead bird, mouse, rabbit, or other animal will often catch owls and hawks; and bluejays, blackbirds, doves, and many other birds may often be caught in box traps.

Steel traps should always be fastened in such a manner that the bird, when caught, cannot flap about and be mussed and injured; and if arranged so that the bird's first effort to escape will dislodge the trap and bring it to the ground, the captive will usually remain more or less quiet after his first few struggles.

Chapter VII

BIRDS' NESTS AND EGGS

IN making a collection of birds' eggs and nests either one of two different methods may be followed. You may collect the nests only, after the birds have left them, and exhibit these with colored drawings or cuts of the eggs, or you may exhibit the nests and eggs together, either with the eggs in the nests or in trays of cotton near them.

Many naturalists and collectors advise taking the entire set of eggs in a nest, as they claim that the bird will desert the nest if only one egg is taken, and that the other eggs will then be wasted. There is no doubt that many birds *will* desert their nest and eggs when disturbed; but, on the other hand, an egg or two may frequently be taken from a nest without the bird leaving it. I never could see any real advantage in taking all the eggs, except to illustrate the variation in color and size of the eggs, or to show how many comprised a set; and these matters, for a boy's museum, are of little importance. The variation in color is usually slight, and the number of eggs in a set can be written down for reference in the catalogue and data-blanks. If you decide really to collect eggs, I advise taking but one egg first. Then return the following day, or within a day or two, and if the bird has actually deserted the nest you may take the remaining eggs without feeling that you have

wantonly destroyed the family, while if she is still faithful to her home you should leave the eggs undisturbed until after they have hatched and left the nest, when the latter may be collected and placed on exhibition with the egg. In collecting eggs and nests, or either one of the two, the most important item to consider is careful identification. Empty nests, save in a few cases, are almost impossible to identify with certainty, and in all cases you should manage actually to see and identify one or both of the parent birds before disturbing their home.

Labels for nests and eggs should contain the name, height from ground of nest, materials of which it was built, kind of tree or bush it was in, date when taken; number of eggs in the nest, when found; name of collector, and any other remarks you consider of value or interest. A standard form of blanks for this purpose may be purchased, or you may print them yourself as follows:

No................**Date**....................
Name....................................
Locality..................................
Collector.................................
Situation.................................
Nest of...................................
....
Eggs in set..............................
Identity..................................
Remarks..................................

If you have a good camera, a valuable and interesting collection of nests and eggs may be obtained without robbing the birds at all. The photographs may frequently be taken, showing the old bird on her nest (Fig. 1), but another should also be obtained showing the nest with the eggs. Of course, such pictures must be taken at close quarters, and by a time exposure or very slow speed. A series of these photographs is really more interesting than real nests and eggs, and will in addition aid greatly in arranging groups amid natural surroundings.

Nests, as a rule, require no particular preparation for the museum. At times, however, they are very loosely constructed affairs of twigs and sticks, and in order to remove them without their falling to pieces, it is necessary to sew or tie them together. By using coarse thread and needles, a few stitches will prove sufficient to secure them in place, and later on finer and better sewing can be done in the workshop, and the old stitches ripped out.

Sometimes a nest will be found that is full of tiny mites or bird-lice. Such vermin should always be sprayed with benzine or formaline, or placed in a box containing an open dish of formaline or carbon bisulphide until all insect life is destroyed. It will not injure the nests to dip them or soak them in benzine or formaline, and this is a very sure and easy way of destroying the bird-lice. Always avoid tearing the nests from the branches or supports on which they are built. It is far better to cut off a good-sized branch or limb, and place the whole in the museum (Fig. 2).

Eggs should be carefully blown just as soon as possible after they are taken; and, while this is very easy to ac-

Fig. 1

BIRD ON NEST

Fig. 2

NEST ON NATURAL BRANCH

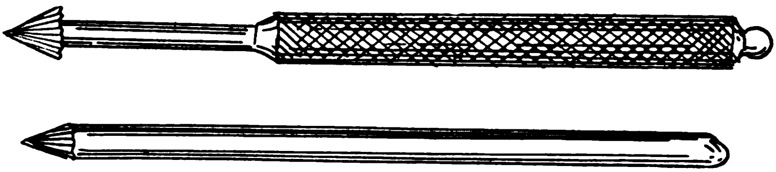

Fig. 3

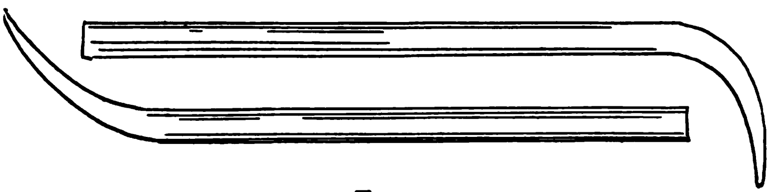

Fig. 4

EGG-DRILLS AND BLOWPIPES

complish after a few trials, you must always handle a small egg very carefully and tenderly. To blow eggs you will require some egg-drills, a blowpipe or two, and some clean water and blotting-paper. Egg-drills and blowpipes may be bought ready-made, but any boy can make them in a few minutes. Egg-drills are merely steel rods with a conical, pointed end with rough ridges or cutting edges on the point (Fig. 3).

Old wire nails with the heads cut off and one end sharpened to a point with a file give excellent results. When filing, rub the file in one direction—lengthwise of the point—and the natural grooves left by the file will form a cutting edge. The blowpipe may be of either metal or glass; and, as the tip is *never* to be placed *within* the hole in the egg, it does not need to be very fine. Glass blowpipes (Fig. 4) are easy to make by merely heating a glass tube red-hot over a Bunsen burner or alcohol-lamp and bending it around at right angles. One of the ends should then be heated and drawn out to a point, and when cool the sharp end should be broken off so as to leave a slender opening at the end.

When your drill and blower are ready you may proceed to blow the eggs. Hold the egg firmly but carefully between the thumb and fingers of the left hand, and press the tip of the drill against one side near the center—if possible, select the side having the fewest markings—and, holding the drill pressed firmly against the surface, twirl it back and forth between thumb and forefinger of the other hand until it bores a small, neat, round hole in the shell. Care must be used not to make the hole too large or broken around the edges, for a very minute hole is all that is required, and a

rough or ragged hole will look badly, and may result in a broken egg when you come to blow it.

Next hold the egg over a glass or bowl of water, and place the tip of the blowpipe close to *but not in* the hole, and blow slowly and steadily. The contents will at once begin to run out, and by blowing steadily and moving the pipe around and over the hole the entire contents will soon be forced out. The egg-shell should then be thoroughly washed out by sucking the pipe half-full of water, blowing it into the egg, shaking it about, and forcing it out by again blowing in air. When thoroughly rinsed, the egg should be wiped off with a fine rag or tuft of absorbent cotton and placed hole down on a sheet of clean blotting-paper to drain and dry. If the egg is large, stale, or partly incubated, you may have to work some time to expel the contents; and it is a great help to occasionally blow water into the egg and shake it about to soften and break up the contents.

Each egg should be neatly marked with its catalogue number, the number being written on the shell close to the hole with a soft lead-pencil or indelible or water-proof ink, and if they are to be exhibited separately from the nests they should be neatly arranged in little trays partly filled with soft cotton batting. Care should be taken that all the eggs are perfectly dry before placing on cotton or in the nests, as otherwise they may adhere to the surrounding objects and become badly broken when you try to remove them.

Perfectly fresh eggs may usually be distinguished from those which contain young birds by the color of the shell, fresh eggs being pinkish or semi-transparent, while incubated

eggs are dull, dead in color, and often show discolored spots. These remarks only apply to eggs in which the ground surface or color is white, and it is very difficult to tell with certainty when a green or blue egg is incubated.

Whenever possible, collect only perfectly fresh eggs, and if you know that eggs are incubated do not disturb them unless they are very rare or desirable.

Small eggs that contain young birds are very difficult or impossible to save, and, as a rule, are not worth the time and trouble; but large eggs, such as those of hawks, owls, ducks, etc., can be saved even if the chick is nearly ready to hatch out. If such eggs have a large bird within, you will have to make a large hole in the shell, and after blowing out as much as you can you can blow in a solution of pepsin and water, or even clear water, and allow the egg to stand, with the hole up, for a few days, when the contents will be softened and decomposed enough to allow you to force them out with the blowpipe and water. Small hooks made from fine wire, tiny scissors, and similar instruments are very useful in removing the contents from badly incubated large eggs.

Finally, I wish every one of my readers to understand thoroughly that unless your parents, teachers, and local game wardens approve of your collecting eggs and birds, and unless you are really interested and aim at a better knowledge of our feathered friends, you had better not collect anything but game-birds and birds of prey. Whatever the cause, our song and insectivorous birds are yearly becoming fewer and fewer, and every bird killed or egg destroyed means one songster less at the outset, with a consequent loss of all his descendants.

Therefore, do not add to the decrease in our birds unless convinced that the benefit you derive is greater than the harm done, and if you *do* collect birds and eggs make up for it by feeding and encouraging other birds in every possible way. Put suet and crumbs where the birds can feed in cold weather; scatter grain and seeds in summer; put up bird boxes and houses, and protect your feathered neighbors in every way, and wage a relentless war upon marauding cats if you wish to preserve bird life in your vicinity.

Chapter VIII

PIRATES OF THE AIR

DID you ever stop to think how many human occupations and trades, and even man's virtues and vices, have their counterpart among birds, animals, and insects? There are insect carpenters and masons among the bees and wasps, insect miners and farmers among the ants; animal masons and carpenters, animal hunters, and animal fishermen, as the beavers, squirrels, wolves, and otters; and among the feathered hosts the woodpeckers are carpenters, the swallows are masons, the water-birds fishermen, and the birds of prey hunters.

Among beasts, birds, and insects we may also find law-abiding, peaceful beings, each working hard and earnestly for a living, while others of their race prove robbers and pirates and, disdaining to work for their livelihood, prey upon the industry of others and rob and pillage at every turn.

Particularly among the birds are robbers found, and as usual "might proves right" in most cases with the feathered pirates. The common osprey is a well-known bird along seashores, lakes, and rivers throughout the United States; he is an untiring and skilful fisherman, and spends a great

Fig. 2

Fig. 1

portion of his time sailing about over the water searching for his prey. As soon as a fish is discovered the fish-hawk drops like a shot, seizes the fish in his talons, and, dripping with water, flaps rapidly upward, bearing his catch in his strong, hooked claws, and heading toward his home or for some convenient perch on which to enjoy his meal. Unfortunately for the osprey, a lazy, bald eagle often lurks in the vicinity, watching every move of the fish-hawk with covetous eyes (Fig. 1). As soon as he spies the fisherman, heavy-laden with his finny prize, the eagle spreads his broad wings and in powerful, majestic flight sweeps down upon his victim, strongly reminding one of a pirate craft bearing down upon a helpless merchantman.

The osprey, well knowing the futility of escape, yet tries every ruse and strains every muscle to evade the white-headed bucaneer, but in vain, and finally, in desperation, he drops his hard-earned prey. Like a flash the hungry eagle swoops and, seizing the fish in midair, wheels and sails to his lofty lookout, while the poor fish-hawk, baffled and robbed, once more wings his way over the surface of the water searching for another fish. Although prone to rob the osprey, yet it must not be supposed that the eagle is dependent upon others for his food, for he is an expert fisherman himself, and as well able to capture his own fish as is the osprey.

Many species of sea-birds are pirates or robbers, and, in fact, the majority of feathered freebooters are found among water-birds, just as the worst of human robbers were the piratical sea-rovers of old. Several species of gulls prey largely upon the eggs of other birds during the breeding

season, and the beautiful, black-headed, Franklin's gull subsists almost wholly upon the eggs and young of the grebes during the early summer (Fig. 2). To make his raids easy and certain, this handsome robber builds his nest in the midst of grebe colonies and helps himself to his neighbors' property whenever he sees fit. Oddly enough, the grebes fail to profit by past experience, and permit the gulls to live among them year after year.

Another small gull, the Kumlien's gull, breeds in the far north, and has similar habits, but in his case he feeds himself and family upon the eggs of the ungainly cormorants that nest in his vicinity (Fig. 3). These big, powerful birds seem absolutely helpless against the raids of the much smaller gull, and are obliged to exercise unceasing vigilance to protect their nests from his inroads.

Nearly all the larger gulls feed to a considerable extent upon the eggs and young of other sea-birds; but the great glaucus, or burgomaster-gull, is not content with this, but attacks and robs full-grown gulls of other species, as well as the guillemots, auks, puffins, and cormorants, and all sea-birds that live in his vicinity dwell in constant dread and fear of the broad-winged bully that robs when and where he pleases, and spares neither large nor small.

In northern waters the "biter" is often bitten, however, for the gulls themselves frequently fall easy victims to the swift-winged jaegers and skuas—birds fitted by nature for the life they lead.

Powerfully built, strong of wing, and armed with a powerful, hooked bill, the skua of the far north in his dark, dull plumage sails abroad like the "black, rakish pirate craft"

of old and, fearless of retaliation, robs gulls, terns, gannets, and other sea-fowls right and left.

Smaller than the skuas, but fully as bold and piratical by nature, are the several species of jaegers that inhabit the coasts of the Atlantic from Florida to the arctic seas. The jaegers depend almost wholly for their livelihood upon robbery, and, while they are able to fish for themselves and when pressed by hunger or through lack of birds to rob they will deign to do so, yet they prefer the life of a marauder, and select the inoffensive and graceful terns for their victims.

Quick and elusive as they are, the sea-swallows are no match for the jaegers, and turn and twist and dodge as they may, their pursuers seldom fail to overtake and rob them.

Every visitor to southern waters must have seen the great, clumsy, brown pelicans that are common along the seacoasts of the tropics. Heavy and slow of wing, these grotesque birds fly about near the surface of the water to suddenly plunge down head first among a school of fish, numbers of which are instantly scooped up in the capacious pouch beneath the pelican's bill. These pelican fishermen fall constant victims to the most powerful and swift-flying pirate of the air: the frigate-bird, or man-o'-war bird, a small-bodied, long-winged, forked-tailed, black-robed robber that swoops and soars and sails about continually on the lookout for a prize. With wings longer in proportion than those of any other bird and powers of flight greater than all save the albatross; with strong, cruel, hooked beaks, not an ounce of spare flesh, and keen, hawklike eyes, these birds are complete masters of the air, and soar for hours at such heights that they appear but mere specks in the intense blue heavens.

With speed, strength, and rapaciousness denoted in every line, the frigate-birds are the embodiments of the ideal pirate (Fig. 4).

Pelicans, cormorants, gulls, terns, boobies, herons, cranes, ospreys, and, in fact, any bird which the pirate discerns with a

Fig. 4

Fig. 3

captured fish proves fair prey for the frigate-bird that with lightning speed drops like a bullet from far above toward the unsuspecting victim. If the object of his attack is in flight, the man-o'-war bird swoops upon it and by sharp blows of beak and pinions causes it to drop its prey, which is seized ere it touches water or ground. Pelicans, however, keep their finny catches securely locked within their pouch while in flight, but in order to swallow the fish they toss it upward in the air, catch it as it falls, and swallow it head first. This brief second provides the opportunity for the robber,

and I have frequently seen a frigate-bird swoop down, seize a fish while in the air between the pouch of the pelican and its throat, and without checking his flight wheel about and repeat the operation as the stupid pelican tossed another fish upward.

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Part III

THE INSECT COLLECTIONS

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Chapter IX

PREPARATION FOR THE INSECT COLLECTION

INSECTS are among the most important members of the animal kingdom, for among them are found the most useful and most injurious of all creatures. Insects annually kill more men than either snakes, carnivorous animals, or most diseases, and, in fact, a large proportion of the most deadly maladies known are spread by insects. On the other hand, millions of dollars' worth of crops are destroyed by insect pests, while other crops fully as valuable are saved to man by beneficial insects; and it is even impossible to raise certain fruits and vegetables without the aid of certain insects.

Indeed, vegetable life would be almost impossible without insects to carry the pollen from flower to flower, while the entire destruction of insects would result in the practical extermination of bird life and a great deal of animal life, and would make even man's existence well-nigh impossible.

The number of insects in the world is enormous, and while thousands of species have been classified and described, new kinds are being constantly discovered, or new and unexpected habits and wonderful life histories are being observed and described by scientists throughout the world.

So numerous in numbers and varieties, so handsome in form and color, or so interesting in their habits are the insects that they are always a favorite branch of animal life with collectors, and the ease with which they may be secured and preserved, and the constant possibility of discovering a novelty, makes insect-collecting extremely interesting and attractive.

Insects may be found everywhere at all seasons, but they are most numerous during warm weather, and with the first warm breath of spring a multitude of insects will commence to stir from their winter's rest, and very soon numerous varieties will be visible to the stroller through spring woods and fields. Many insects have a very short life of but a few days or hours, while others are very particular as to the season when they appear in public; and so, to have anything like a complete collection of the insects found only in your own vicinity, you must be prepared to collect and preserve them at any and all times. It is so nearly impossible to collect all the insects found in one locality that it is far better to specialize on some certain group and make this as complete as possible before taking up the next group. Of course, any chance specimen that you see while looking for something else should be secured, however, for in all natural-history collecting you must take advantage of opportunity. If a certain species is passed by with the idea that it is common or can be secured at any time, the chances are that you may find it impossible to obtain it when you really require it; wild things, especially insects, have a way of getting very scarce when they are wanted, and many species that are common pests one season

may be extinct or extremely rare and valuable the next year.

During the early spring many beetles, flies, wasps, and small moths and butterflies are very common, but later on these will disappear entirely and will be supplanted by other species, while moths and butterflies that are few in number early in the season will increase in numbers and varieties as the summer advances.

Unless you have collected or observed insects already, you will be greatly surprised at the infinite variety you can easily obtain, even in a very limited district or in a city, and the more you collect and examine them, and the better you learn their odd and interesting ways, lives, and habits, the more you will wonder, and the more interested you will become. For collecting insects you will require comparatively few tools and appliances, and these may nearly all be made at home or purchased at a very small cost.

The most important things for collecting are as follows:

A good insect net, a small trowel, a pair of fine forceps, a stout, strong-bladed knife, some empty tin boxes (old tobacco boxes are good), a tin box or pail with a perforated cover, a lot of square pieces of smooth, rather stiff paper, cyanide bottles, and a few vials of alcohol or formaldehyde. The net (Fig. 1) should be of stout, thin cloth or bobbinet, and should be at least ten inches in diameter and eighteen inches deep, and you can easily sew this up yourself or get your mother or sister to do it for you. The exact shape is immaterial, for some collectors prefer a long, pointed bag (Fig. 2), while others prefer a broader, square-bottomed bag (Fig. 3). In either case the seams should be smooth and

free from little uneven pockets or wrinkles, and around the upper edge, or opening, there should be a band of heavier cloth, or a double thickness of the same cloth, where the net is fastened over the ring.

The ring, or hoop (Fig. 4), can be easily made of stiff iron or brass wire (heavy galvanized telegraph-wire is first rate), and should be bent as shown The two ends AA should be tied together with wire and placed in a tin or brass ferrule which has been previously stuffed half full of *dry* sand (Fig. 5), and melted lead should be poured in around the wires. As soon as the lead is cold the net can be sewed to the hoop, a smooth handle about five feet long fitted to the ferrule, and the net is ready for use.

Any old trowel and jack-knife will do for those two tools, as they are merely used for digging in soft earth and rotten wood. Cyanide bottles may be purchased ready-made for a trifle, but they are easily made at home; and if the cyanide of potassium is bought in just the right quantity for the bottle and is *all* used up, there will be no danger of leaving it around where some one may get hold of it and be poisoned. To make the cyanide bottle get a strong, wide-mouthed bottle or small jar with a tight-fitting cork or glass stopper, and place a layer of cotton in the bottom. Scatter about an ounce of cyanide of potassium, in lumps, on the cotton, place a little more cotton on top of the cyanide, and then pour in plaster of Paris and water (as mixed for casting), about half an inch thick over all. Just as soon as the plaster is hard the bottle is ready for use, but great care should be taken to keep it tightly corked at all times, for the fumes of the cyanide are very deadly. Any insect placed in this

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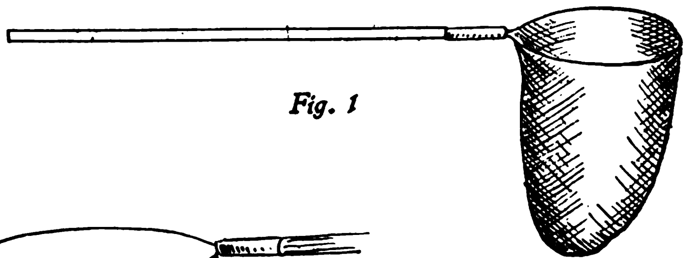

Fig. 1

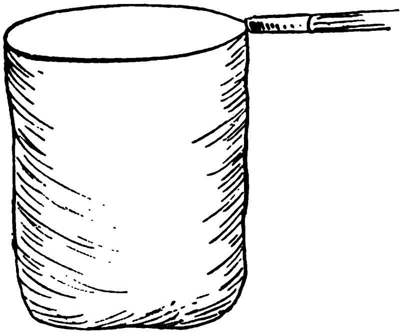

Fig. 3

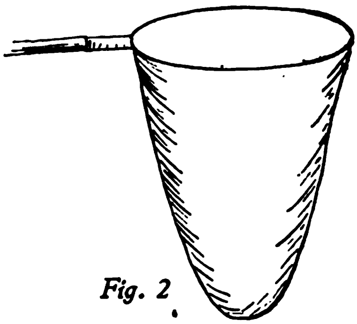

Fig. 2

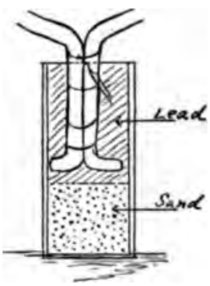

Fig. 5

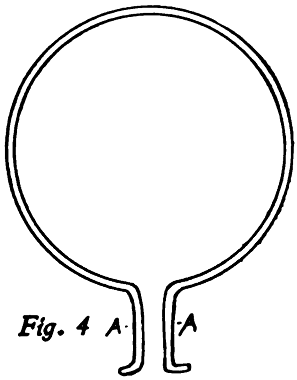

Fig. 4

THE MOST IMPORTANT THINGS FOR COLLECTING

bottle will die without a struggle almost instantly; but butterflies and moths should never be placed in a bottle, and it is best to have several bottles of various sizes for different kinds and sizes of insects. If cyanide bottles are considered too dangerous, or if the collector is very young, it is better to use bottles of alcohol or formaline solution for the beetles and hard-shelled insects and drop the specimens in these. If the solution is not too strong—about twenty-five per cent. alcohol or two to five per cent. formaline—the insects will not be injured or faded, and if taken out within a short time, they may be mounted readily.

For killing moths and butterflies, benzine or gasolene is best, and a bottle of either of these may be used for the hard-coated insects instead of the alcohol or formaline, if desired.

The tin boxes should be clean, roomy, and with numerous perforations, as they are intended for carrying live caterpillars and larvæ; and for convenience in carrying they should be of various sizes, so that one may be packed within another when empty. The square pieces of paper are very important items, for these are intended for carrying freshly killed moths and butterflies. They should be of assorted sizes, and some little practice will be required in order to acquire the knack of folding them properly so as to protect the insect and yet not injure or rub it.

To use these papers they should be creased or folded as shown in Fig. 6, and the specimen placed within as illustrated in Fig. 6*a*. The edges are then folded over as indicated in Fig. 6*b*, and the paper with the insect safely held within should be placed in a tin or wooden box where it will be secure from injury until ready to mount. The papers

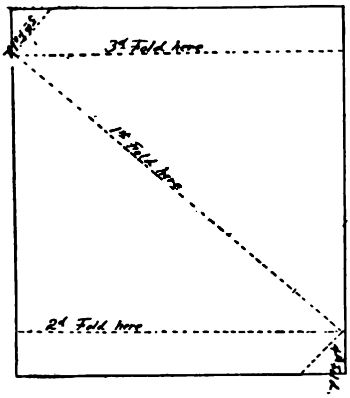

Fig. 6

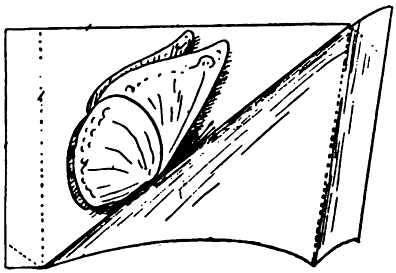

Fig. 6a

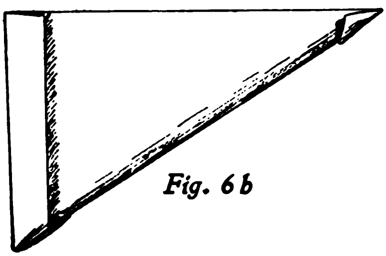

Fig. 6b

containing the specimens should be packed quite snugly and smoothly in the box, for if allowed to jolt and shake about they may be seriously injured. Soft cotton batting may be used to place over the papers to hold them in place, and as the papers filled with insects accumulate the cotton may be removed gradually and placed in the box, from which fresh papers are taken.

Chapter X

INSECTS AND THEIR WAYS

IN order to become a successful insect-collector you must learn the habits and haunts of each class and kind of insect and the most likely places to hunt in. You must have patience and perseverance, and have sharp eyes and be observant. Many insects depend upon their striking resemblance in color or form to some object among their surroundings. Various caterpillars look so much like dead twigs or sticks that they would pass unnoticed by a person unfamiliar with their habits (Fig. 1), while the odd and interesting "walking-stick insects" (Fig. 2) look even more like bits of the twigs and branches among which they rest. Certain butterflies that are easily seen when flying about disappear as if by magic when at rest, owing to the lower side of their wings bearing such a very close resemblance to dead leaves or masses of lichen (Fig. 3). Still more remarkable is the counterfeit presented by beautiful large, forest-loving moths of the genus *Catocala*. These moths are commonly known as "underwings" from their brightly colored red, yellow, and black lower wings. Their upper wings are invariably mottled in dull grays, browns, etc., and when resting they alight

Fig. 1

Fig. 2

Fig. 3

EXAMPLES OF MIMICRY

upon the bark of trees where their colors blend so perfectly with their surroundings that they are practically invisible (Fig. 4). The best way to get these handsome fellows is to look over the trees carefully, and if a moth flies off watch the exact spot where he alights on another tree, and then approach very cautiously. When close to the moth slap him sharply and squarely with a flexible but rather stiff piece of cardboard. If this blow is delivered in the right way the moth will fall stunned to the ground and practically uninjured, and may be killed by a few drops of benzine on his thorax. If you attempt to capture these insects in a net they will slip out from beneath and escape.

Beetles are very easy to collect, for they are very numerous and live in all sorts of places and seldom can fly or run fast enough to escape. Under stones and logs, in decaying wood and fungi, and beneath the bark of trees are fine places for finding beetles. Some species live on flowers, especially on goldenrod and milkweed (Fig. 5), while others feed upon green leaves. Still other species are carnivorous, and prey upon other insects. These carnivorous beetles are usually quite quick in their movements, and readily take to their wings when danger approaches. Lady beetles belong to this class, as well as the brilliantly colored tiger-beetles that live on hot, sandy paths and fly quickly away at the approach of the collector.

Other species of beetles feed on decayed fruit, and by visiting old fruits and vegetables, previously placed out to decay, many rare species may be obtained. Still other species of beetles live on carrion, and by turning over dead animals or birds or cow dung many species of these scaven-

Fig. 4

CATOCALA MOTHS IMITATING BARK

gers can be secured. They are usually brightly colored and rather handsome species (Fig. 6), and, although they live in such disagreeable spots, they are well worthy of a place in the collection and are very interesting in their habits.

Fig. 6

Fig. 5

By constantly digging out below a dead animal these little creatures finally succeed in actually burying the carcass. The eggs are then deposited beside the body, and the young larvæ, upon hatching out, feed upon the mass of decaying meat. Such beetles are known commonly as burying-beetles or scavenger beetles, a name they well deserve. Ground-beetles can almost always be found under stones and

logs, and, while over one thousand species of these beetles are known in the United States, yet many of them are rare or very handsome in appearance, and the habits of many are but imperfectly known. In rotting and partly dead wood many species of boring beetles live, and in digging and chipping at such places the old knife and trowel will come in very handy. In the rotten wood you will often find grubs or larvæ of many beetles, and these should be preserved in alcohol to illustrate the life history of the group. Other beetle larvæ live in the ground or under stones, and these may be either long, slender creatures known as wireworms or fat white grubs with brown heads. The former are the young of the odd snapping-beetles, while the fat, white chaps are the larvæ of some kind of June-bug or stag-beetle. It is very hard to raise beetle larvæ to maturity, and difficult to identify the species, but a few of each kind are interesting when preserved in alcohol or formaline to show what beetle larvæ look like.

If you find a tree or branch well riddled with boring-beetle holes you should cut out a section, and later on, with the adult and larval forms mounted in their natural positions, this will form a most interesting part of the insect collection. Formerly the large museums avoided all natural forms of mounting, and placed each specimen by itself on a stiff painted mount, but nowadays they strive to make their specimens look as natural and lifelike as possible, and take great care and trouble to mount them in groups in their natural positions among all their native surroundings. It is always a wise plan to make sketches and notes of all the peculiar features of the material or spot where your best

specimens are obtained, so that you can duplicate the surroundings accurately when you mount the specimen for exhibition. Although most insects—with the exception of wasps, bees, and hornets—are harmless, it is a wise plan to handle all doubtful insects with a pair of forceps. This will obviate any danger of being bitten or stung, and you will be less liable to injure the specimen.

Many fine rare specimens of wasps, beetles, flies, and moths may be obtained by "sugaring." This may be done either at night or in the daytime, and two methods may be followed. The first is to make a thick, syruplike mixture of sugar, molasses, vinegar, water, and beer, and paint it over tree-trunks, fences, or rocks in woods and orchards. The other method is to use a thinner mixture of similar composition and place it in jars, pails, or bottles suspended from trees or bushes. By visiting the trees painted with the thick mixture at night with a lantern large numbers of rare and beautiful moths and night-flying insects may be obtained. The jars, on the other hand, need only be visited every two or three days, as the insects attracted by the mixture fall into the bottles and drown, being stupefied by the beer. Beetles, wasps, flies, etc., may be readily washed off when caught in this way, but moths or butterflies are usually ruined. Sugared trees and fences will also attract many butterflies and other insects during the day, and more fine specimens can be thus obtained than in any other way.

By placing a bull's-eye lantern in the woods at night, or in an open field or meadow, many night-flying insects will be attracted, and can be readily captured with the net, while a lamp in an open window will often bring fine results

on a warm, close evening in summer. Traps may be constructed of muslin or bobbinet, and are merely square or oblong frames covered with the material, and provided with a funnel-shaped opening at one end and with a lantern placed at the other with a screen of bobbinet in front of it. The moths and other insects are attracted by the light, and find their way into the funnel, but cannot get out, and the screen before the light prevents them from beating their wings to pieces on the lamp.

Another fine collecting-ground for beetles is the shore of a large lake or the seashore. Insects fly over the water and are drowned in large numbers; and, while the majority are devoured by fish and birds, a great many are washed up on the shores and may be found under the dead seaweed and trash thrown up by the waves. I have taken a great many rare species in this way that I have never found elsewhere.

Another splendid collecting-ground for night-flying insects such as moths, beetles, flies, etc., is around the electric arc lights of the city streets, and if you live near a small country-town with electric lights, or on a suburban street or avenue with arc lights, or, better still, near some large electrical-lighted park, you will reap a splendid harvest of specimens by watching around the lights on warm summer evenings. Myriads of insects are attracted by these lights, and, while a great many beat themselves to pieces against the globes or find their way within and are burnt up, large numbers become dazed or stunned and fall to the earth beneath, where they may be readily secured. A net, a cyanide bottle, and your insect-papers and benzine are required for this work, and in a single evening you may fre-

quently secure more fine rare moths in this way than by weeks of collecting in woods and fields.

Butterflies are mainly creatures of the open fields and pastures, and love heat and sunshine, but some species prefer dark and damp woods and never appear in the open. Some butterflies are always found about wayside mud-puddles, while still others feed upon carrion and decaying fruit. Butterflies must be caught with the net, and, while this sounds very easy, you will be surprised to find how often you will miss until you have had considerable practice. Butterflies seem to delight in tantalizing the young collector by flitting away just as the net descends, only to alight a little farther on and repeat the performance over and over again until the insect-hunter is hot, tired, and thoroughly disgusted. A little patience, care, and practice will save much disappointment in capturing butterflies. They should never be approached rapidly, for a sudden movement will almost invariably frighten them. Do not attempt to use the net until you are sure you are within reach; then make a sharp, quick side sweep with the net, and immediately turn it so that the bag folds over and prevents the captive from escaping; never bring the net down *over* a butterfly unless he happens to be on the ground, or in some similar spot where a side sweep is impossible. As soon as the net is twisted, as directed, gather the bag up carefully and hold the folds close enough together to prevent the insect from thrashing about. Grasp the butterfly through the net between the thumb and finger at the thorax and press firmly. The butterfly will then be temporarily unconscious, and he may be removed and killed with

benzine and placed in the folded paper provided for the purpose. If the captive's wings are open in the net or there is danger of rubbing or injuring him, it is wise to pour a little benzine over him before touching with the fingers; but, no matter which method you employ, you should be most careful to avoid rubbing or touching the wings when extracting the insect from the net, and when placing in the paper great care should be used, and you should be particular to see that the wings are folded neatly together over the back and that there are no creases or folds in them.

Caterpillars are very important things to collect, for by rearing these you may secure absolutely perfect specimens of moths and butterflies of many species that are difficult or impossible to obtain otherwise. Whenever a caterpillar is found he should be placed in one of the perforated boxes with a few leaves of his food-plant, and you should always make a note of the leaf or bush on which he was found. Each kind of caterpillar has a certain kind of food-plant, and, although some kinds will eat various sorts of leaves, the majority of species will eat but one kind, and will soon starve unless the proper food is provided. When you reach home the leaves or twigs should be placed in a bottle of water, with cotton or paper stuffed in the mouth of the bottle around the leaves, and the whole placed in a breeding-cage with the caterpillar. Several species of caterpillars may be placed in the same cage with the various leaves upon which they feed, but too many should not be kept together, and it is better to keep only one species in a box. The breeding-cage may be merely a box or jar with a wire netting or thin muslin cover, or it may be quite an elaborate affair

with hinged doors, growing plants, earthen floor, etc. For single caterpillars a flower-pot covered with a wire fly-screen may be used, or a growing plant in a pot may be covered by tying a piece of muslin or mosquito-netting over the whole (Fig. 7). Leaves for the caterpillars should be changed daily, for they will not devour dry or wilted leaves, and you will find that the amount of food that a healthy caterpillar consumes is really wonderful. No matter how much they eat, you must provide enough and some to spare, and the cages should be kept clean and neat, with plenty of air and light. Handle the larvæ as little as possible, and if they are of the kind that burrow in the earth to transform to a pupa you must provide earth for that purpose. If not sure of their habits, provide earth anyway. As soon as the pupa or cocoon is made the cage should be undisturbed until the moth or butterfly emerges. Most caterpillars that pupate early in the summer will produce moths or butterflies the same season, but those that transform late in the summer will remain in the chrysalis form all winter and will emerge the next spring. These are usually healthier if kept out-of-doors over winter in a sheltered spot or in a dry cellar. If the pupæ are in the earth they should be protected by covering the cages with straw, leaves, or some similar substance.

As preserved caterpillars and pupæ are important parts of a well-arranged insect collection, it is a good plan to have several of each kind whenever possible, and the ones selected for specimens may then be killed and preserved when fully grown and healthy.

The moths and butterflies that emerge from the pupæ

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Fig. 7 REARING INSECTS *Fig. 8*

Fig. 9 INSECT PARASITES *Fig. 10*

will be very soft and juicy when they first hatch out, and they should not be disturbed or touched until fully expanded and dry. When an insect first emerges the wings are merely small, wrinkled pads, while the body is very large and fat (Fig. 8). Very rapidly, however, the juices of the body flow out through veins and channels, the wings expand and smooth out, and as the body decreases in size the wings increase, and the owner moves them slowly back and forth until they assume their full size, color, and strength. Even when they are fully developed the creature will not attempt to fly away for some time, and it is during this period of rest, after the wings are developed to their full extent, that the specimen should be killed. Moths should be removed and killed in the daytime and butterflies at night, as at these times each is sluggish and not likely to flutter. Where large moths or butterflies are being raised great care should be taken to have the breeding-cages large enough to give plenty of room for the insects to expand their wings. If the larvæ have been raised in small individual boxes, these should be placed open within a large cage when the pupæ have been formed, so that the emerging insects will not be cramped.

Sometimes pupæ or cocoons will prove most surprising and disappointing, for instead of a handsome or rare moth or butterfly appearing a small fly or wasplike insect will emerge from the chrysalis (Fig. 9). These are parasitic insects, known as tachina-flies or ichneumon-flies, and do a world of good by keeping insect life in check. The eggs are laid in the living caterpillar, and the young fly larvæ live within the body of their victim with no external sign of

their presence. When the caterpillar transforms to a chrysalis the young fly also forms a pupa, and, while the caterpillar dies, the fly pupa lives and eventually comes forth from the caterpillar's pupa. Other species mature more rapidly than the caterpillar victim, and a short time before the latter is ready to pupate the fly larvæ transform to cottony cocoons on the exterior of the caterpillar's body. Such infested caterpillars are often seen, and, as they are interesting exhibits, they should be preserved in alcohol or formaline and arranged near the preserved caterpillars and adults of the same species (Fig. 10).

The flies that emerge from the pupæ should also be preserved, and the chrysalis from which they appear should also be saved and both mounted near the normal specimens of the species. A knowledge of insect parasites is very valuable and of vast importance, and such a knowledge has many times saved millions of dollars' worth of grain or fruit. Some years ago the fruit orchards of California were being devastated by tiny scale-insects, and nothing could be done to check the destruction until insect experts from the Department of Agriculture imported certain European lady-beetles that fed upon the scale insects and soon checked their depredations. At the present time there are numerous entomologists scouring all parts of the world to find insects that are parasitic on the gipsy-moth and brown-tail moth that have destroyed vast areas of woodland in New England. As soon as a parasitic fly or other insect can be obtained that will stand the New England climate and will live upon the caterpillars of the pests the gipsy and brown-tail moths will rapidly decrease and nature will accomplish results far

beyond the power of man. Native insects seldom become very injurious on account of the many parasites that infest them, but foreign insects accidentally imported, as is the case with the scale-insects and moths mentioned, have no parasite enemies in their new home, and their native enemies are seldom imported with them.

Chapter XI

PREPARATION AND ARRANGEMENT OF INSECTS

IN preparing your insect specimens for exhibition you will require a number of special tools and appliances, but most of these can be made of odds and ends around the house, while those that must be bought are so cheap that the cost is hardly worthy of consideration.

Insect-pins, mounting-boards, a caterpillar oven, a pair of fine scissors, needles, and old visiting-cards are the most important items for preparing the specimens, while cases, mounts, and pressed flowers and leaves will be used in mounting them.

The insect-pins must be purchased of dealers, but they are very cheap, costing but a few cents per thousand. Ordinary pins will *not* answer, and the insect-pins should be kept on hand in several assorted sizes.

The needles, of various sizes, should be mounted in soft, wooden sticks or handles, with the points out, and are used in arranging and spreading small insects.

The mounting or spreading boards may be purchased ready-made, but they are very easy to make and consist merely of two pieces of board cut as shown in Fig. 1, with two smooth pieces nailed on as indicated in Fig. 2. On the

lower side of the open space between the boards a piece of cork should be fastened as indicated in Fig. 3. This may be a piece of sheet cork, which is inexpensive and a handy thing to have, but sections cut from old bottle corks and tacked over the opening, or a strip of corrugated pasteboard such as is used for mailing pictures, will serve just as well.

These boards should be made in several widths and with various-sized openings for all sizes of insects. The old visiting-cards should be cut into strips of various widths and lengths, and kept neatly assorted in little boxes or envelopes. These are all the tools required for mounting beetles, wasps, flies, and moths or butterflies. For preparing caterpillars the oven and straws and scissors will be used. The oven is merely a piece of tin cut in the shape shown in Fig. 4, and folded up as indicated by the dotted lines. The edges are then bent over and riveted, as shown in Fig. 5, and a piece of clear glass placed over the top (Fig. 6). Any small scissors will answer your purpose, and small cuticle-scissors sold for manicuring use are excellent. The forceps already described in the list of tools for the general use of the museum will also be very useful in arranging and mounting insects.

To mount a moth or butterfly, hold the specimen firmly between thumb and finger at the thorax, with the wings folded together over the back (Fig. 7), and press an insect-pin down through the thorax (the hardest part of the body just behind the head), just in line with the front edges of the wings (Fig. 8). Push the pin through the body until a little more than half its length projects below the body. Next pin the insect in the groove of a mounting-board so

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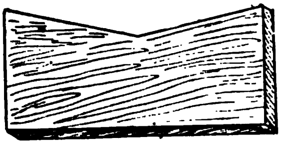

Fig. 1

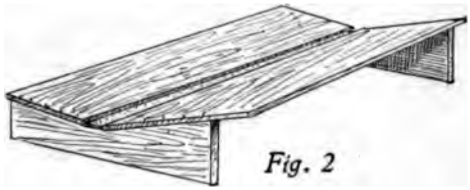

Fig. 2

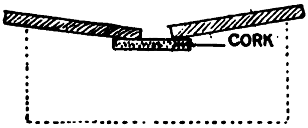

Fig. 3

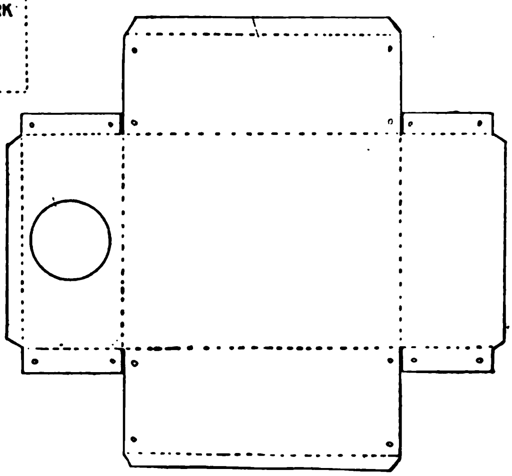

Fig. 4

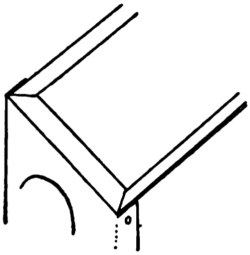

Fig. 5

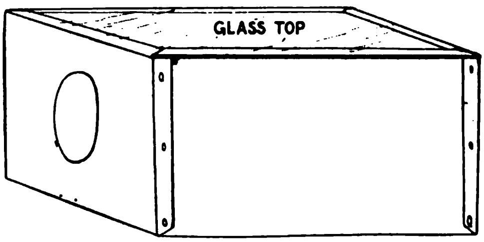

Fig. 6

SPECIAL APPLIANCES FOR PRESERVING INSECTS

that the back of the body is just level with the two side boards. In selecting the board to be used be sure to choose one with a slot deep and wide enough to accommodate the body without cramping, but not much wider, and with side boards wide enough to allow the full width of the wings and a little more, for if the wings project ever so little beyond the edges they are liable to be injured or broken. When placing the first insect on a board begin at the top, as in this way the board may be filled up with insects without injuring or disturbing those already in place (Fig. 9). As soon as the insect is pinned in the groove take one of your needles in a handle and press the wings on one side down to the board, spread them in a natural position, and pin them temporarily in place with very fine pins inserted close to, or through, the large veins on the edges of the wings. Proceed in the same way with the other wings, and be careful to have the wings on each side in exactly the same position, and perfectly in line across the board. To render this easier it is well to rule ink lines across the boards from side to side, at varying distances, and these will serve as guides for the forward edges of the wings. Now take some strips of cardboard, selecting pieces longer than the breadth of the wings, and place them gently across the wings. Pin these securely to the board by common pins placed *outside* of the wings (Fig. 10). Lift up and arrange the fore legs and antennæ, or feelers, and secure them with tiny strips of card as shown in the cut. If the body shows any tendency to twist to one side or the other of the groove, it is best to fasten it in place by pins placed on each side, against it.

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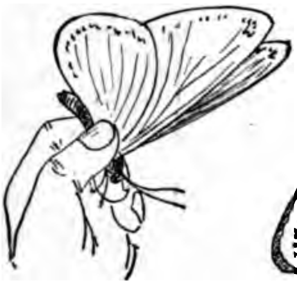

Fig. 7

Fig. 8

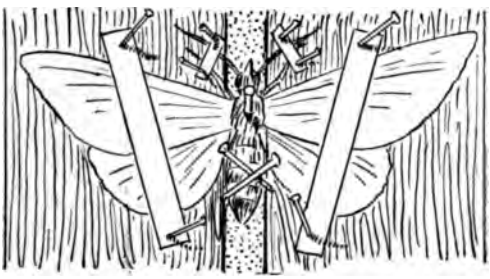

Fig. 10

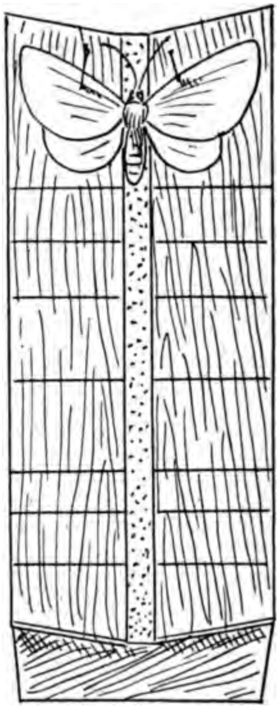

Fig. 9

The board with the mounted insect should now be set away in a safe place to dry. It should be put in a cool, dry spot free from dust, and where insect pests or wind cannot reach it. If placed in a large closet or case, it will be safe, but closed drawers or boxes are not advisable, as plenty of air should reach it. Never place insects in bright sunlight, as the colors will fade rapidly. If your specimens have been kept some time, and are dry or stiff in the collecting-papers, they must be relaxed, or softened, before

mounting. This is accomplished by placing them on a sheet of blotting-paper, in a tightly covered box half filled with wet sand or sawdust, which has been sprinkled with a few drops of oil-of-cloves or formaline to prevent mold. Insects treated in this way will soften up in a few hours, but it is a wise plan always to mount your insects just as soon as possible after they are killed. If they have been kept in the papers for some days, do not try to open them while dry, but put papers and all in the softening-box. Many moths and butterflies are very different in color and pattern on the upper and lower sides of the wings, and in such cases a specimen should be mounted wrong side up in addition to the one right side up (Fig. 11). Other species have bright-colored lower wings and dull-colored upper wings, and such species should be mounted with wings spread to show both pairs of wings, and another specimen prepared with the wings folded in the natural resting attitude. Wasps, bees, flies, ants, and hornets, as well as all soft or semi-soft bodied insects are mounted like moths and butterflies, but beetles are treated in a slightly different way.

These insects should be pinned through one side of the body, back of the thorax (Fig. 12), if intended for study specimens, but if they are to be arranged in groups or among natural surroundings, they should not be pinned at all, but merely secured in position on a board by bits of soft paper pinned over them and pins run diagonally across the sides. Beetles do not require a mounting-board for their wings unless it is desirable to show the wings expanded, but the legs and antennæ should be arranged and dried in a lifelike manner (Fig. 13).

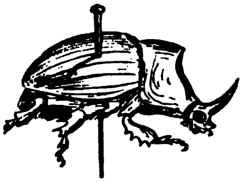

Fig. 12

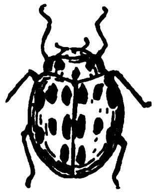

Fig. 13

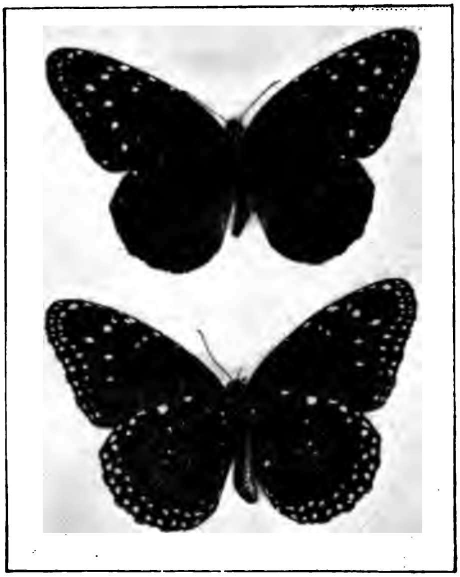

Fig. 11

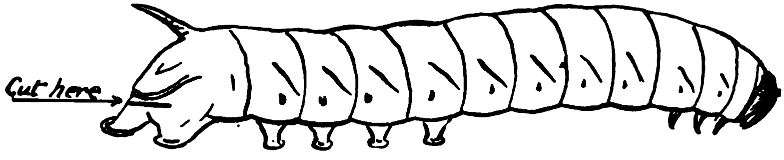

Fig. 14

MOUNTING INSECTS

In the preparation of caterpillars and larvæ quite a little skill and practice is required. Place the specimen—freshly killed by the cyanide bottle—on a piece of clean blotting-paper, make a small incision between the two hind legs with the small scissors (Fig. 14), and with another blotter press firmly on the caterpillar, working from the head backward, until all the contents of the body are expelled through the slit. The oven, already described, should now have a layer of sand about half an inch thick spread over the bottom, and should be placed on a small stove or over a lamp until quite hot. Now place a straw in the slit in the caterpillar's body, and blow gently until the body skin fills out plump and naturally. If the slit is too large and slips off the straw, it may be pinned in position with a small insect-pin. While still blowing gently on the straw place the caterpillar in the oven through the round opening, and continue to keep the skin inflated while constantly turning it round and round until the skin becomes perfectly dry and stiff. The whole process can be watched through the glass cover, and great care should be taken not to brown or scorch the caterpillar. Many species will turn dark or brownish as they dry, but with a little care and practice you will learn just how hot the oven should be, how long it will take to dry caterpillars of a certain size, and how to distinguish between the change of color due to drying and real scorching or burning. As soon as the caterpillar is dried he should be removed from the oven, turned about a few times in the air until cooled, and then placed on a sheet of soft cotton to remain until ready for mounting. Smooth-bodied caterpillars are far easier to prepare than those

covered with hair or wool, but it is a very easy matter when once you get the hang of it. Some collectors fill the dried skins with paraffin or wax, and beautiful specimens can be prepared in this way. If a natural attitude is desired, the caterpillar must be carefully bent in the proper position as he dries, and great skill is required to secure a natural position without wrinkling or creasing the skin. Sometimes a drying caterpillar will assume a natural attitude of itself, and in such cases no attempt should be made to alter it. If cyanide is not used the caterpillars may be drowned in fresh water by filling a bottle to the top and corking it, but cyanide bottles are far quicker and result in better specimens.

If the dried skin changes greatly in color from the natural tints you will have to go over it with tube-colors and a fine brush, and touch it up. For this reason color sketches should be made of each caterpillar preserved, and these will serve as guides for coloring the skin later on. Of course, where living caterpillars of the same species are on hand you can use these for guides to coloration. Preparing and coloring caterpillars is rather a difficult job at the best, and, unless natural groups showing the life history of insects are desired, photographs of living caterpillars, colored by hand, will answer every purpose. Such pictures are easy to obtain, and may be placed in the cases with the mounted adults and pupæ of the species. Fig. 15 shows how well such photographs represent the natural attitudes and appearance of caterpillars.

In arranging your insect collection for exhibition you may use one of several different methods, or you may combine

[redacted]

Fig. 15

Fig. 16

Fig. 17

INSECTS IN NATURAL ATTITUDES

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several. For a study and exchange collection it is desirable to pin the specimens in trays or boxes with cork bottoms, and each specimen should be plainly labeled on a slip through which the pin is passed (Fig. 18). Such collections should be kept in dark drawers or closed cases, away from light, and are intended for reference, study, and exchange, or to form a reserve from which to select specimens to replace those on exhibition that become injured or faded.

Fig. 18

For exhibition purposes the specimens may be mounted in the same manner in glass-covered boxes or trays, or they may be arranged in separate glass-covered mounts securely sealed. This class of mounts is the safest and easiest method, and the mounts known as "Riker mounts" may be purchased at a dealer's, or may be easily constructed from shallow cardboard boxes and old glass. The box should be filled with soft, smooth layers of cotton, and the insect (after cutting off the projecting pin) placed gently upon it. The glass cover is then carefully laid across the top, pressed firmly down, and secured in position by gummed strips of paper pasted around the edges of the glass and box. This method prevents ravages of moths or other pests, allows the specimens to be freely examined, and makes handling and arranging very safe and easy.

Such mounts, in large sizes, serve excellently for arranging groups of caterpillars, pupæ and adults together, or for arranging any kind of insect amid its natural surroundings. Dried flowers, leaves, twigs, etc., may be placed on the cot-

ton, the insect placed in the proper position, and the whole covered with the glass and sealed (Fig. 17). Very interesting groups may also be made by arranging insects that imitate their surroundings in such a way as to illustrate their protective form or color. Other insects may be mounted with their cocoons (Fig. 16); or caterpillars that make nets or tents may be mounted to show this habit. If you wish to specialize in insects I advise dividing the collection up into several exhibits: one showing protective colors or forms, another showing parasites, another showing life histories, etc. Many insects have very peculiar habits, and you should always endeavor to illustrate these in your collections. Examples of this sort are the carpenter-bees and wasps. The common carpenter-bee makes a long tunnel in wood, and a piece of wood cut away to show this habit makes a very interesting exhibit. Carpenter-wasps have similar habits, and several small bees make their homes within the stems of trees and bushes (Fig. 19). Many moths have the male and female so different in color or size as to appear like distinct species, and in all such cases it is of great importance to have both sexes mounted (Fig. 20). In still other insects one sex will be common and well known, while the opposite sex may be unknown to science. This is the case with the *pelicinus;* and any boy who happens to stumble on specimens of both sexes of such insects will rank among the famous naturalists. Oftentimes otherwise excellent collections are woefully lacking in very common but interesting everyday things. It is seldom we find an insect collection properly exhibiting the various forms of common bees with their workers, drones, queens, and comb, or even showing the

Fig. 19

NEST OF CARPENTER-BEE

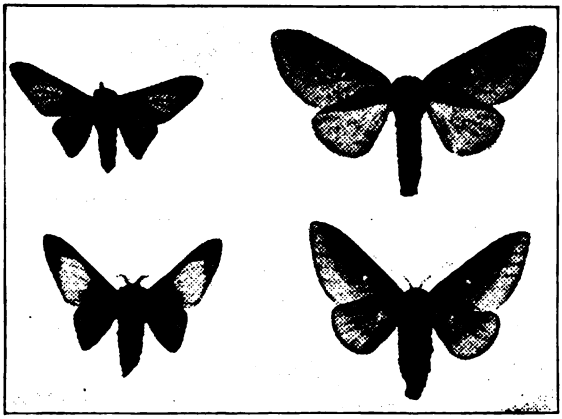

Fig. 20

MOTHS, SHOWING VARIATION IN MALES AND FEMALES

"pollen baskets," on the hind legs of the common bumble-bee.

Pupæ and cocoons are in some ways fully as valuable as the adults or larvæ, and may be prepared by simply killing them by soaking in alcohol and drying, but where a cocoon covers the chrysalis the latter should be shown outside of the cocoon.

Even the eggs of moths, butterflies, and other insects are of interest, and no collection showing the life history of an insect is complete without the eggs. Eggs are just as serviceable for specimens after hatching as before, and by waiting for them to hatch doubtful species may be identified. They require no preparation other than placing the leaves or twigs bearing the eggs in a glass-covered box to protect them.

If you once start your insect collection I am sure you will find it the most interesting one of all, and even if you do not make it complete you cannot fail to learn a great deal about the life and habits of these little creatures, and how greatly they influence the entire outdoor world.

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Chapter XII

SOME REMARKABLE ANTS

OF all the lower animals none are more interesting or more worthy of the boys' attention than the ants. They appear to exhibit actual intelligence at times, and their social life, skill, organization, and habits often seem as if actuated by almost human brains. Even our commonest ants have remarkable habits if we observe and study them closely, and they are so common, so numerous and so readily found and watched that any boy in any place can find a number of species to observe.

One of the commonest habits is that of keeping aphids, or plant-lice, as human beings keep cows. The ants not only secure food in the shape of a sweet substance known as "honey dew" from their tiny cattle, but feed and care for them as well, even building little sheds over their herds to protect them from rain. If the plant on which the aphids are feeding dies or becomes poor pasturage, the ants carry their cattle to better feeding-grounds. When cold weather approaches they carry the eggs and pupæ of the plant-lice to their own homes and care for them tenderly through the winter, and when the eggs hatch in spring place the young aphids on healthy plants, where they will be sure of abun-

dant food. The aphids are not the only insects cared for, however, some species of leaf-hoppers being treated in much the same manner.

Several kinds of beetles, spiders, and wasps live within the dwellings of the ants in perfect harmony with the rightful owners. Some of these guests no doubt render their hosts valuable services in return for board and lodging, but others prey regularly upon the young ants, and it is one of the mysteries of ant life as to why they are permitted to remain unmolested. The larvæ of some of these guests closely resemble the young ants, while others are very unlike them and require a very different sort of food. When one of these larvæ considers it meal-time he strokes the face of an ant in a very comical manner, and the ant immediately obliges it with a drop of honeylike fluid on its lower lip, which is eagerly devoured by the beetle (Fig. 1).

Fig. 1

BEETLE SOLICITING FOOD FROM ANT

Many of the large red ants are slave-holders, and, curiously enough, the slaves are almost always black! When a colony of ants requires slaves a regular army is formed, skirmishers are thrown out, and scouts are sent ahead to discover a nest

of black ants and look over the ground. The invading army is composed entirely of warrior ants with powerful jaws quite different from the common workers. When the nest of the intended victims is reached, a fierce battle at once takes place and many are killed and wounded on both sides. The more powerful invaders are always victorious, however, and, entering the nest of the vanquished blacks, they rob it of eggs and pupæ, which they carry off to slavery in their own home. The returning victors are welcomed upon their arrival with various manifestations of joy, and the young of the defeated foes are taken within and carefully tended until fully grown. Strangely enough, the slaves thus obtained are willing and obliging servants, doing all the harder work of the community, even to feeding their captors. Indeed, some species of slave-holding ants are incapable of feeding themselves, and if it were not for their slaves they would die of starvation even in the midst of plenty.

Although our northern ants are so interesting, it is in the warmer portions of the world that their most remarkable habits are seen. In Texas the "agricultural ant" raises regular crops of certain species of grass, the seeds of which they harvest and store away in well-built granaries. Their little farms are very carefully tended, all weeds and encroaching plants are carefully destroyed, and the soil is kept loose and manured.

The "army-ants" of tropical America are remarkable for the immense numbers in which they travel from place to place, devouring every particle of animal food in their path. Sometimes in the course of their marches they enter houses, and, although the occupants are compelled to vacate for

the time being, they welcome the visiting ants, as upon their departure they are sure to leave the dwelling free from roaches, rats, mice, and all other pests, even the pet cat or dog being at times destroyed. Apparently, these army-ants do not possess the sense of smell, for walking-sticks,

Fig. 2

ANT-PLANT (HYDMOPHYTUM MONTANUM) ROOT SECTION, SHOWING NATURAL GALLERIES

walking-leaves, and other protectively formed or colored insects frequently save their lives by remaining motionless when overtaken by the army, the ants even passing over them, evidently unaware of the food existing in the semblance of a twig or leaf.

A relative of the army-ant, and found in the same localities, is known as the "leaf-carrier." These fellows march along in single file, each one carrying a triangular piece of green leaf above his head. The bits of leaf are used in building a home

and in cultivating a sort of fungus used as food, and, apparently, only one kind of leaf is ever used. Frequently the ants are obliged to travel many miles in order to secure the leaves, and the endless procession of moving bits of green winding up hill and down dale along a well-worn path presents a most curious appearance. Ants have many kinds of nests, some in wood, others in trees or bushes, and still others between leaves. The most curious ants' nest in the whole world, however, is found in Java, and is known as the "ant-plant," from the fact that the large woody root of this plant is almost invariably inhabited by a certain kind of ant (Fig. 2). The curious part of it, however, is that the chambers, galleries, and tunnels are not made by the ants who live within, but are naturally formed, ready for tenants, by the growth of the plant itself. Perhaps the most wonderful habit recorded of any ant, however, is that of an Asiatic species which lives in nests constructed of leaves fastened together with silk. Whereas the adult ants have no means

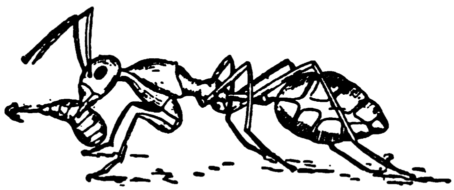

Fig. 3

ASIATIC ANT USING A LARVA TO FASTEN LEAVES TOGETHER

of spinning this silk themselves, their young possess a small quantity with which to form their cocoons. Their parents avail themselves of this in a manner so remarkable as to be

scarcely credible. While several of the ants hold the edges of two leaves together another member of the family grasps a larva in his jaws and rubs its mouth along the seam, whereupon the young one at once excretes its silk in a sticky fluid state (Fig. 3). As soon as the supply of one larva is exhausted another is brought, and the operation is repeated until all the seams are safely and strongly glued together by the aid of these living mucilage bottles.

Part IV

FISH, REPTILES, AND BATRACHIANS

Chapter XIII

COLLECTING

THE animals included in this department of your museum are probably the most difficult to prepare of any group. They are very interesting and quite important, and nearly every boy is deeply interested in fishes, turtles, frogs, and snakes.

Under these circumstances it is well worth while to practise until perfect specimens are prepared; and as most of the creatures in this section are readily collected, you can secure an abundance of specimens on which to work. While this practice is going on any odd or rare specimens may be preserved in alcohol or formaline until other specimens of the same kind are collected and mounted; or, if necessary, the alcoholic specimens may be prepared almost as well as fresh ones. Many of the larger museums depend mainly upon alcoholic specimens to represent the groups included in this division; but, although such specimens are all very well for study or strictly scientific work, yet the general public cares very little for them, and visitors can obtain but a very vague idea of the real living appearance of the creatures by seeing them crowded into a bottle of formaline

or alcohol with their colors faded or lost and many of their parts hidden or distorted by the curvature of the bottle.

There are a great many species of fish in almost any locality; and, while some are found only in salt-water and others only in fresh-water, yet other species are found in both salt and fresh water. Sturgeon, salmon, and other fish belong in this class, and if you live in a district where both fresh and salt water fish occur you should divide the collection into two parts—one for fresh and the other for salt water species. You can then place those that inhabit both places between the two distinct classes. It is not necessary to have very large specimens of fish, for, as a rule, the small or medium-sized ones are easier to obtain and prepare, and take up much less space, and at the same time show the form, arrangement of fins, and the colors just as well, or even better, than large specimens of the same species. Fish may be found in almost any stream, pond, lake, or other body of water, and they may be caught with nets, seines, hook and line, or in traps made of wire netting stretched over a frame or constructed of lathes like a lobster-pot (see chapters on marine animals).

Fish may be skinned and stuffed, but this requires a great deal of skill and practice, and even then they are usually more ridiculous than lifelike in appearance. It is far better to make plaster-of-Paris or wax casts and color these by hand. By this method the original specimen may be preserved in alcohol for study and the cast used as the exhibit. The method of casting fish is exactly like that employed in casting snakes, frogs, turtles, etc., and will be described fully later on.

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Many common fish may be easily reared in an aquarium, and a well-conducted and well-stocked aquarium is a very interesting part of a museum. Do not try to have the aquarium ornamental, but get the plainest one you can find, with plenty of glass on the sides. A splendid kind to use for the museum is made entirely of glass, and can be purchased at any dealer's, and is very inexpensive.

Any boy can, however, make an aquarium for himself if he is handy with carpenters' tools, for the main thing is to make the joints water-tight, and this is an easy matter if marine glue is employed. This is a rubberlike substance that is for sale at every dealer's in boat or yacht supplies, and when heated it can be used like putty. When cold it is very strong, rather hard, and expands and contracts with the variations in temperature without cracking or leaking.

Small fish are the best ones to keep alive, and, if possible, select those that have interesting habits; a few stickle-backs with their odd nests, or some pumpkin-seeds or suckers and bullheads are always of interest, while dace, small perch, and one or two small carp or goldfish add color and variety. You should always aim to keep both carnivorous and plant-eating species together, but be sure your carnivorous species are much smaller than the herbivorous species, or otherwise you will soon have nothing but the meat-eating kinds remaining.

By keeping both kinds together there will be no decaying vegetable or animal matter to contaminate the water and dirty the glass, for each kind will devour what the others refuse. In addition, you should always keep a few water-snails and some water-plants in an aquarium, and if the

various forms of animal life are well proportioned the water need never be changed.

A layer of clean sand and some pebbles should be placed on the bottom of the aquarium, and if there is room you may also keep a few small turtles, a frog or two, and newts or salamanders in the same aquarium. As a rule, however, it is best to have each class of animal life by itself. For turtles an open box, partly filled with earth or sand, and with a dish or pan of water, will answer just as well as a glass aquarium, and frogs may be kept in the same way if a sheet of glass or some wire netting is placed over the top. Of course, where glass is used you must provide holes for air and ventilation in the sides of the box.

One of the best places in which to collect turtles, snakes, frogs, newts, etc., is an old mill-pond or shallow lake. You will be surprised to find what a great variety of creatures inhabit such places; and although you may not think that you are interested in frogs and similar objects at first, yet when you once get started you cannot fail to become very deeply interested in the mill-pond denizens.

Most of these creatures are very easy to collect, and the tools and implements required are few and simple, and can easily be made by any boy. Reptiles and batrachians are in some ways very much alike, and in other respects they are very different. Many boys as well as grown-up people are at a loss to distinguish between the two groups, and always call all sorts of batrachians "reptiles," while salamanders and newts frequently are known as "lizards."

In reality, all batrachians are smooth-skinned, without scales, and have internal gills adapted for breathing under

water. Among batrachians are the frogs, toads, salamanders, newts, mud-puppies, and similar animals. Reptiles, on the other hand, have lungs for breathing air and have a skin covered with scales or horny plates of some sort. Among reptiles are the snakes, turtles, lizards, horned toads, Gila monsters, and similar creatures.

Most batrachians are either slimy or slippery, and many species exude mucous or watery substances, as in the case of toads, tree-frogs, and many other species. Reptiles, on the other hand, are not slimy or slippery, but have a dry, hard surface to the scales. The illustration of a Gila monster (Fig. 1) shows the appearance of a typical reptile,

Fig. 1

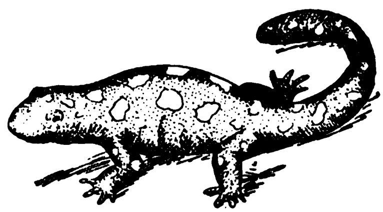

Fig. 2

and the illustration of a salamander (Fig. 2) indicates clearly the differences between this batrachian and the reptiles.

Dip-nets, an old rake, an old dipper, with holes punched in the bottom, and turtle traps are most essential. With the punctured dipper fastened to a long pole you can scrape up the mud, dead leaves, and sand from the bottom, and in this way secure numerous fresh-water snails, crustaceans, small frogs and turtles, newts, etc. Among the things obtained in this way will be numerous curious little cases or

nests of pebbles, shells, straws, etc., each of which contains a wormlike occupant. These are the homes of caddis-fly larvæ, and belong in the insect collection. Their habits are so very interesting and odd, however, that a number should be kept alive in a jar or aquarium for study and observation. Fig. 3 shows several forms of these odd structures. The small creatures obtained by use of the dipper should be dropped into alcohol or formaline at once, and may be classified, labeled, and prepared at leisure. With the old rake you can pull in great piles of muck, fallen leaves, and water-plants, and among these you will find a host of interesting creatures that you never dreamed lived in the pond. Turtles, frogs, newts, queer little crustaceans, shells, and many young eels and fish will be found in this material, and if the collecting is done early in the spring you will often secure many good-sized fish and turtles as well as tadpoles and frogs' eggs. The dip-nets will come in handy for catching frogs, turtles, and fish, and turtle traps will secure more turtles in a day or two than you could catch in any other way in months. Fig. 4 shows one form of turtle trap, which is really nothing but a wooden box with perforated sides and with a cover made in one or two pivoted sections (A) which can be tipped down, but not up, owing to the cleats (B), and are held in place by the stones (C). When weighted and placed in the water, with the top an inch or two above the surface, it makes a very attractive object for turtles to crawl out on to sun themselves. Just as soon as the turtle crawls on to the trap-door his weight tips it down, and he slides into the box. The stones then pull the top back into place, and the trap is again ready for the next

visitor. The only care necessary is to get the weights just heavy enough to hold the pivoted pieces in place, for if too heavy, the weight of the turtle will not spring the trap. It should be set in some spot where turtles are abundant; and no bait is required, as the turtles are attracted to the

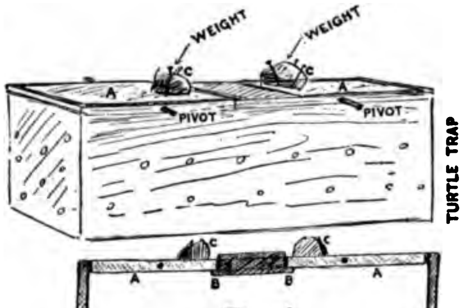

Fig. 4

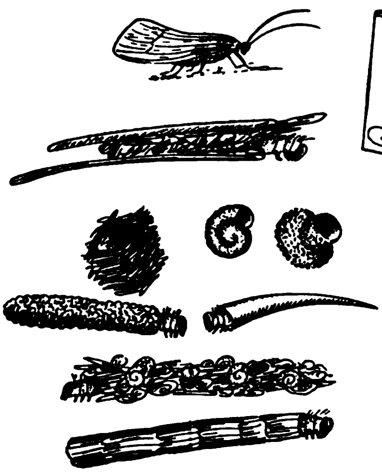

Fig. 3

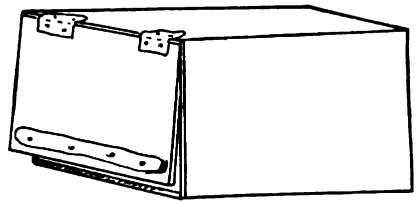

Fig. 5

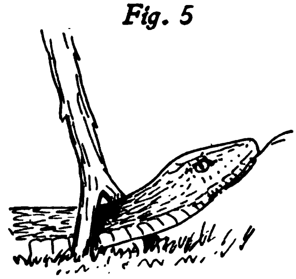

Fig. 6

trap merely to sun themselves. For this reason the trap should be placed in a good sunny spot, and the top should slant from about an inch above the water at one end to three or four inches above it at the other. This is easily accomplished by nailing a cleat or board across one end at the bottom so that the trap naturally rests at an angle.

Another excellent form of trap is shown in Fig. 5. This is still simpler in construction, as it merely is an old box with a door, or end, that can swing in and not out. At the bottom of the door there should be a crack, or opening, about half an inch wide, and the trap must be baited with old meat, dead fish, or similar substances, and weighted down beneath the surface of the water in a pond or lake. The turtles attracted by the bait will try to push inside beneath the door, and the door will swing in with them; but just as soon as they are inside the box the door will swing shut and prevent their escape. In order to be sure that the door will always swing to, some pieces of iron or lead should be fastened to the lower edge on the inside. Otherwise the wooden door will have a tendency to float open, and will swing back and forth and allow the captives to escape.

Many species of frogs and toads, as well as most snakes and numerous species of turtles and salamanders, spend a great portion of their life on dry land. These should be sought for under stones and old logs, among brush heaps and under dead leaves. Nearly any snake may be safely handled by grasping it by the neck; but if you are nervous or live in a district where poisonous species occur, you should capture these reptiles by pinning them down with a forked stick placed over the neck (Fig. 6). Turtles, frogs,

toads, and salamanders should be kept alive, when possible, until ready to preserve them, as freshly killed specimens are much easier to prepare and make much better mounts than those kept in alcohol or formaline even for a few hours.

The best way to kill snakes or other reptiles or batrachians is by the use of potassium cyanide, prepared in jars exactly as described in the chapters telling how to collect insects. Even a large snake or turtle will die very quickly when placed in a cyanide jar, but large-sized creatures may be more easily disposed of by drowning or chloroforming. All these cold-blooded creatures are very tenacious of life, and even when apparently dead may suddenly revive and crawl away. Always be sure that the creature to be killed is left long enough to be really dead before commencing to work on him. It is very awkward to have a partly skinned snake suddenly come to life or a frog that is being cast commence to kick and ruin all your work.

If snakes, turtles, frogs, etc., are placed in jars of alcohol or formaline for ten or fifteen minutes, you may be sure they are dead, and if not kept longer than this they are just as easy to prepare as fresh specimens, and, in fact, are really easier to skin in most cases.

Chapter XIV

PREPARATION OF FISH, REPTILES, AND BATRACHIANS

SNAKES, turtles, fish, and frogs may all be stuffed and mounted; but, with the exception of the turtles and snakes, such mounted specimens are usually more ridiculous than useful, and are exceedingly difficult to prepare except by an expert. Large snakes, however, are not so very hard to stuff, and I will therefore describe how to stuff and mount both turtles and snakes.

To skin a turtle or tortoise place the creature on his back and with a sharp knife cut through the skin and flesh where it joins the lower shell. Then with a fine saw and knife cut through the edges of the lower shell where it joins the upper (Fig. 1). The lower shell may then be readily lifted off with a little cutting of muscles, etc., and the entire internal anatomy of the creature will be exposed. Clean out the inside thoroughly, leaving legs, tail, and neck untouched. Then cut through the lower joints of these so that the neck, legs, and tail are loose, and proceed to turn them inside out exactly as is done in skinning a bird's leg. You will have to go slowly and carefully, as the skin often sticks firmly to the flesh, but it is easy after a little practice. When the claws of the feet and the base of skull are reached you

should clean off all flesh and fat and coat with arsenic or arsenical soap. Now run a light wire up through each leg and out of each foot and tie it to the bones inside. Wrap the leg-bones and wire with soft tow or fine excelsior, and form it to the shape of the real leg by winding with soft strong thread. A wire should also be run up through the neck and top of head after cleaning out the brains, eyes, and other animal matter in the skull through the base of same. The neck should then be formed on the wire as on the legs, but of course in this case there will be no bones. Now turn the legs, tail, and head back, bring the inner ends of the wires together inside the shell, and twist them firmly together as in Fig. 2. Now fill in all around these wires near the edge of the shell with cotton or tow, leaving a space in the middle where the ends are twisted together. Care should also be used in having the wires long enough so that the legs, tail, and head can be pulled out or in on them until they lie in the same position as in the unskinned turtle. When all these adjustments are made fill in the space where the wires are exposed with plaster of Paris, and allow it to harden thoroughly. Next stuff the edges of skin next to the legs, tail, and head with cotton, and stitch the edges together from side to side and end to end until they are even, and leave an opening only slightly smaller than the lower shell (Fig. 3). When this is accomplished lay the lower shell in place and mark where the side joints come, and bore two small holes through each edge of the lower shell and through the corresponding edges of the upper shell. Through these small copper wires should be run, their ends twisted together, and the stuffed turtle is ready to be mounted upon a suitable

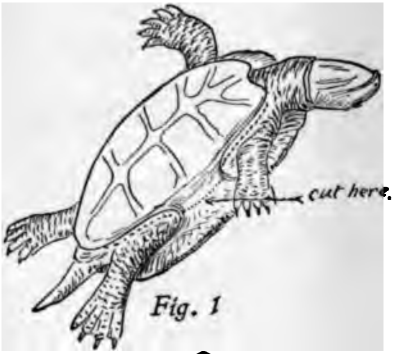

Fig. 1

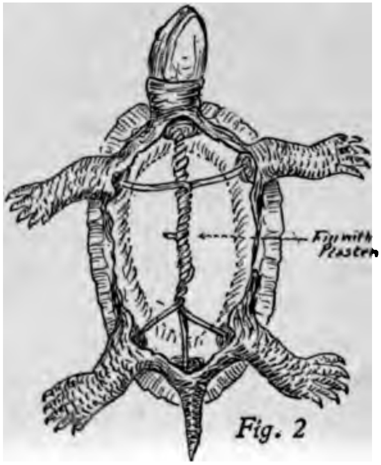

Fig. 2

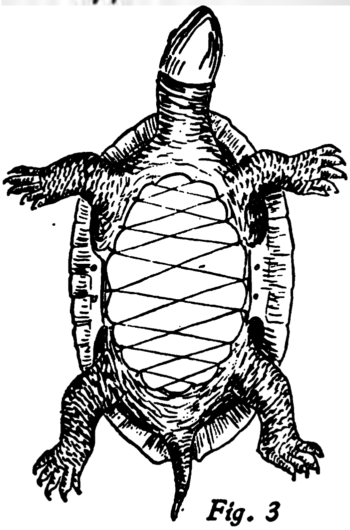

Fig. 3

Fig. 4

base by running the leg wires through holes made for the purpose. Try to get the head and legs in a natural position, and after everything is arranged to your satisfaction place the specimen away until dry. When dry any brightly colored portions of the creature's skin should be touched up

with tube oil-colors mixed thin with turpentine, and when this is dry the entire animal should be given a thin coat of transparent varnish.

In stuffing a snake the body may be removed from the skin through a narrow slit in the lower side an inch or two in length. As soon as the skin is separated from the flesh completely around the body for the length of the slit (Fig. 4) a string should be tied around it and the snake hung up to a hook, beam, or nail. You may then proceed to skin toward the tail, turning the skin inside out as you did the turtle's neck and tail. When the tail is all skinned work from the slit in the other direction until the head is reached. You will find a great deal of care is required in skinning the head without tearing the skin or injuring the bones. When thoroughly clean, cut the body free, coat the skin with arsenic, and turn right side out. The skin may then be filled with fine white sand or sawdust, the slit sewed up, and the reptile placed in a proper attitude until dry. If sawdust is used the snake will only require touching up with paint and varnish, but if sand has been used it is best to shake out the dry sand through the slit and replace with dry sawdust. This is really a very simple and, if care is taken, satisfactory way to mount snakes; but far better results can be obtained by slitting the lower side for nearly its entire length, turning the skin back, and making a proper excelsior or tow body molded like the real one. This body should be formed around two wires with their ends twisted together (Fig. 5), and one of these ends should project and be placed inside the skull, where it should be secured by plaster poured around it. As it is next to impossible to make the body smooth and

bend it afterward, it should be bent into the position desired and after winding as smooth as possible should be given a thin, even coat of wet potters' clay. The clay can be smoothed and worked until every muscle and curve of the real body is represented, and then, while still damp and sticky, the skin should be stretched over it and the edges of cut sewed together. Fish and frogs, as well as salamanders, are sometimes stuffed, as I have already mentioned, but it is far more satisfactory to exhibit plaster casts of them than the real animals. Such casts are easy to make, are moth and decay proof, and the originals may be kept in alcohol in addition. Moreover, such casts may be duplicated any number of times from the original molds, and you can probably trade such duplicates to other boys for their collections. To make these plaster molds and casts requires some fine clay—such as is used in making earthenware or fine bricks will answer—a quantity of plaster of Paris of the best quality, and some soft paraffin dissolved in benzine, or, if you cannot get this, some raw linseed oil. As making casts of fish, frogs, and salamanders are all similar in method, I shall describe how to make a cast of a fish in detail, with additional hints on casting frogs. Before killing your subject make careful color sketches of the creature, for the colors rapidly fade after death, and the entire beauty and success of your cast depends upon the accuracy of its coloring.

Having made your color sketch, take a lump of wet clay (it should be wet enough to mold readily, but not wet enough to stick to your hands) and place it on a smooth board. Smooth and work this down until flat and level and a little

larger than your fish. Now place your fish upon the clay, and press it down gently until it leaves an impression in the soft clay beneath. Lift the fish carefully, and with any handy tool, such as a knife, bits of rounded and pointed wood, etc., dig out the clay where the imprint of the fish shows. Place the fish in the hollow thus made and press

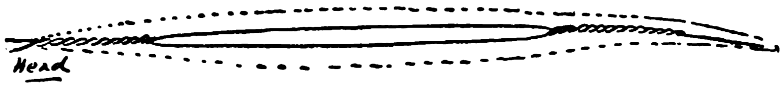

Fig. 5

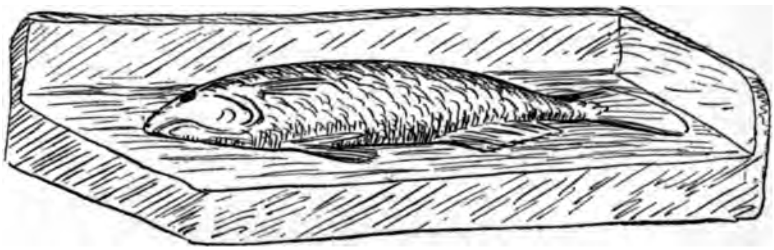

Fig. 6

down again. Dig out more clay, and proceed in this way until the fish rests in the hollow, with exactly half its thickness above the clay. If any little irregularities or cracks show around the edges, they may be smoothed off or filled up, until all is smooth and even and the dead fish forms a bas-relief upon the clay (Fig. 6). Now, with a needle in a handle or a fine pair of forceps, stretch out the fins in a natural position, and by pressing them against the damp clay they will remain in position. Sometimes they have a tendency to spring out of shape or fold up, in which

case they should be fastened down by pin points run through them into the clay, care being taken that the ends of the pins—the heads, of course, cut off—do not project above the surface of the fins.

When all is arranged build a wall of clay around the outside of your clay base to about half an inch higher than the highest point of your dead fish's body. Now mix up plaster of Paris and water to the consistency of thick cream, and stir it until free from air bubbles. Pour this gently over the fish, tapping the board or blowing upon the poured plaster to break any air bubbles, and continue until the whole fish is covered and the plaster fills the mold to the top of the walls. Leave the mold for several hours, or until thoroughly dry, before disturbing it. Then tear down the clay walls, turn the whole affair upside down, lift off the clay base, and in all probability the fish will come with it. If not, get hold of one fin, or a gill, and wiggle and work it gently until it comes free from the mold. You will now have a perfect impression of your fish in plaster, and this mold must be dried thoroughly before proceeding to take a cast. After the plaster is no longer damp brush over the entire inside and lower surface with your dissolved paraffin or linseed oil. Let this soak in, and give it a second coat. Then place the mold upside down, build clay walls around it to a half inch higher than mold, and pour in plaster as when making the mold. When this is hard you can readily free it from the mold by using care and tapping gently, and if your work has been well done you will find that you have a white plaster bas-relief of your fish perfect in every detail. The cast should be well dried and then colored accurately

from your colored sketch. The slab or background of plaster may be left white or may be colored to suit your own fancy.

In making casts of frogs or salamanders greater care and skill is required, for in these creatures a bas-relief is not satisfactory and a complete impression must be obtained, and in order to do this a mold in two pieces must be made. To make such a mold place your specimen on a slab of clay and build up underneath with clay until the creature is in a natural position. Then fill in with clay until every rounded part of the body, legs, etc., is just one-half covered with the clay (Fig. 7). A wall should now be built around the whole and the plaster poured as already described. When this is hard turn the mass upside down, remove all the clay, but do not disturb the animal. Brush over the edges of the plaster already cast with paraffin or oil, cut some little cone-shaped hollows in the plaster, and inclose all with a wall of clay. Now place a little roll of clay on one side of the plaster (where it will show the least in the finished cast) and fill up this side of the mold with plaster again. Your animal will now be entirely inclosed in plaster, and after it is dry the two portions of the mold may be easily separated and the animal removed. The inside of the mold should then be coated with oil or paraffin as before and the cast made by placing the two halves of mold together, tying it firmly with string and filling with plaster through the "gate" formed by the roll of clay mentioned. As it is usually a very delicate and difficult matter to cast a frog or salamander entire without breaking the legs or toes, it is well to leave clay between these and under them before making the second half of the mold. This serves as a base in the

Fig. 7

Fig. 8

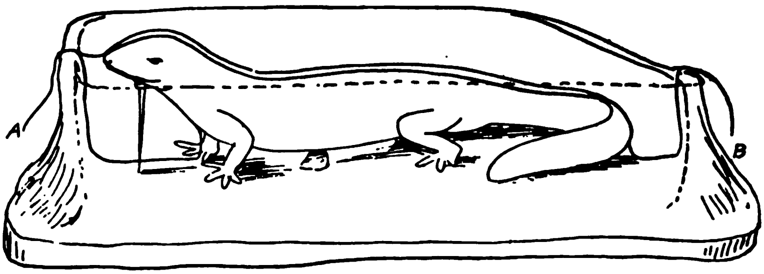

Fig. 9

finished cast, and is readily accomplished by leaving a portion of the original clay in position when making the mold (Fig. 8).

Although this may all sound like a lot of work, yet really you will find it intensely interesting; and, having learned to cast fish, etc., you will constantly be looking for new things to reproduce in plaster. Moreover, later on I shall speak of making wax fruits for your plant collection, and, as the molds for these are made in exactly the same way, it is well to practise on as many things as possible. Snakes may be cast exactly as are the fish, and even tadpoles can be arranged to show their various stages in the development to a frog and cast in the same way.

Many museums are using casts to a large extent nowadays, and such huge creatures as the giant squids, or devil-fishes, full-grown whales, etc., are now exhibited in the form of plaster and paper casts in many of the largest museums of the country.

Very beautiful results may also be obtained by making the casts of your specimens in wax. The molds should be made exactly as for plaster casts, but instead of using plaster of Paris to pour into the finished mold wax of some sort is employed. The best wax that I have found for this purpose is a mixture of hard paraffin and beeswax—about half and half, with about one-half as much Japanese wax added. The whole should be melted together and stirred thoroughly before using. The wax may be left its natural whitish-yellow color, or it may be tinted as desired by adding finely ground artists' colors. Where the finished cast is to be wholly colored by hand the plain wax is best, but if the object cast has a decided uniform ground tint it helps a great deal to color the wax before using.

After mixing your wax it is best to pour a small quantity of the melted mass onto a piece of damp plaster of Paris to test its hardness and ability to strip from the plaster without cracking or sticking. If it remains rather soft and adheres to the plaster, you must add more Japanese wax or a little bayberry wax; if it is too hard and brittle, add more beeswax and paraffin. Too much beeswax makes the mixture contract badly when cooling, and does not give a good impression, and more paraffin should be added. Too much Japanese wax makes the mixture hard and brittle and liable to crack, while an excess of paraffin will make the wax stick

to the mold and will take a poor impression. Medallions of fish may be cast solid in the wax, but for turtles, snakes, frogs, etc., hollow casts are preferable, as better impressions are obtained and the cast is far lighter and also easier to remove from the mold. It is very easy to make hollow casts, but the mold must be first soaked in water and then drained, and must be wrapped tightly with string or thread to keep all the parts firmly in place. After this is done pour melted wax into the hole left for the purpose, and when the mold is about half-filled plug the hole with a bit of damp clay, and then turn the mold round and round in every direction, occasionally giving it a few shakes back and forth, so as to be sure that the molten wax reaches every portion of the inside of the mold. Keep up the motion of the mold until the wax left in the dipper, or other receptacle, is hard, and then drop the mold into a pail of cold water.

Leave it in the water an hour or so, but cut through all the strings or threads just as soon as you put it in the water. Finally take the mold from the water, drain it, and tap lightly here and there with a piece of wood and work the parts of the mold gently back and forth until they commence to loosen. Dip the mold into water every few moments, and very soon some one piece of the mold will come loose from the wax. As soon as one piece comes free it will be easy to get off the other pieces, and if your work has been properly done you will have a very beautiful hollow wax cast remaining.

This sounds like a long and difficult process, but it is really very easy, and after one or two trials you will succeed in getting beautiful casts every time. If a cast should

stick to the mold and refuse to come free, or if portions of the wax remain sticking to the plaster, the wax may be removed by soaking in gasolene, but you cannot make another wax cast in the same mold, although it will answer just as well for plaster casts.

The finished wax cast may be readily colored with tube oil-paints, and if kept away from direct heat or sunshine these wax models will last for many years.

Another excellent method of making molds and casts of irregularly shaped objects, such as lizards, snakes, frogs, turtles, etc., is by using gelatine molds.

To prepare the gelatine soak some sheet glue in water, using just enough to cover it, until soft, and then melt it in a glue-pot or double boiler over a fire. When thoroughly soft add a few drops of glycerine and stir it well. Take some of the glue out and let it harden, and if it becomes brittle or cracks when bent it must have more glycerine added. If too much glycerine is added it will become too soft and remain mushy. By trying the mixture several times you will be able to get the proportions of glycerine and glue just right, and the glue, when cold, will be fairly flexible and soft, but will not tear or rub to pieces readily nor break or crackle when bent.

Now select the object to be cast, and set it up in a lifelike position by small wires, pins, or bits of clay to prop it in place, and surround it with a wall of clay about half or three-quarters of an inch higher than the specimen (Fig. 9). When this is done lay a thread or fine string along the upper surface of the object as shown in AB in the illustration; and if it does not lie flat you can secure it by painting the animal

with olive-oil or thin vaseline and laying the string in this, but be sure the ends of the string project beyond the clay wall. If the object to be cast is a frog, fish, or other smooth and rather slimy creature, you will not need to grease it, but if a turtle, lizard, or snake it must be greased over with vaseline or oil.

When these matters are arranged you can pour in the melted glue until the object is completely covered and the glue fills the inclosure to the top of the clay walls. Shake the glue down by slightly jarring the whole, and allow it to stand undisturbed until you are sure it is thoroughly cool all the way through. Now remove the clay walls and pull on the ends of the thread. The thread will cut through the gelatine and divide it in two parts, and by bending the sides a little you can pull out the specimen, the bits of clay used for props, and any wires or similar objects. Now grease the inside of the mold with oil, tie it together by a strip of tape wrapped about it, and surround it closely with a wall of clay, being sure to place the mold bottom-side up so that the holes left by the bottoms of the feet in the specimen and by the clay props are uppermost. Now mix up the plaster of Paris and pour the mold full through these holes, and let it harden. The clay walls can be then removed, the tape unwound, and the plaster cast pulled out from the two halves of the gelatine mold without any trouble about undercuts or complicated pieces.

These gelatine molds can be used over and over for a number of times, and if by accident the original is destroyed or injured you can make another by using the plaster cast in place of the original specimen.

Chapter XV

FISH THAT WALK AND FLY

THIS sounds funny, does it not? Nearly every one has heard of flying-fish, and, odd as this seems, the idea of walking-fish appears stranger yet. However, the truth often proves stranger than fiction, as the old saying goes, and many people find it easier to believe some impossible tale than to accept some unusual and yet truthful story of remarkable habits of animals. This reminds me of a story told me by an old sea captain. When a boy he sailed to the West Indies, and upon his return told wonderful yarns of the mountains of sugar and rivers of rum. People did not seem much impressed with these stories, for they had seen rum and sugar in such large quantities brought from the West Indies that they almost believed the yarns, but when the young sailor told of flying-fish his hearers at once set such tales down as fiction pure and simple.

Every traveler to the tropics is familiar with the appearance of flying-fish at a distance (Fig. 1). As the ship plows her way through the deep blue waters of the Gulf Stream the flying-fish spring upward from the waves and sail off

to right and left a few feet above the surface of the sea. After flying a short distance they disappear in the water again. Sometimes they appear singly, at other times in twos or threes or in large flocks. They seem to sail rather than fly, and skip along much like a flat stone skipped across the water, for their "wings" move so rapidly that they are almost invisible.

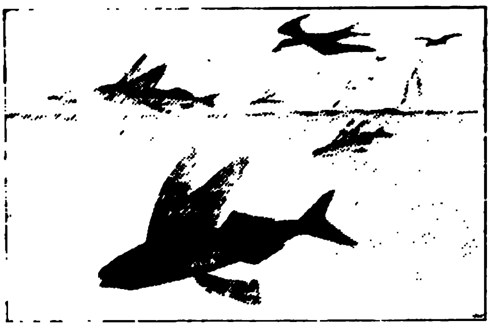

Fig. 1

If we visit one of the West India islands and go to the fish market we will find large numbers of these flying-fish for sale, for the West-Indians consider them a great delicacy and net them in immense numbers at night. If we examine one of the fish we will find that they are from three or four inches to a foot in length, with round, cigar-shaped bodies, dark, steel-blue above and silvery, golden, and purple below. The so-called wings we will find are the pectoral or side fins, which are very large and covered with thin, transparent membrane. There are a number of species of these true flying-fish found in the tropical seas, but all are much alike in general appearance. Their power of flight is apparently given them to aid the little fellows in escaping from their enemies below the sea. It often proves fatal to them, however, for gulls, boobies, and other sea-

birds swoop down and seize them while flying, and the fishermen take advantage of their habits to capture them.

The fishing-boats go out at night and stretch a long net from one boat to another in a semicircle. Then other boats row toward the net, beating and splashing the water, and the flying-fish, alarmed, take refuge in flight, only to flutter helplessly into the nets. Sometimes several boat-loads will be thus obtained in a single night. The flying-fish moves very rapidly and with considerable force. Once, while rowing along the coast at night, one of these fish flew up and struck one of my negro boatmen on the elbow. The force of the blow was sufficient to cause the man to drop his oar, and frightened him almost to death.

In addition to these true flying-fish of the tropics there are a number of other fish possessing winglike fins which enable them to fly for a short distance. The commonest of these are the gurnards and sea-robins. In tropical waters these are very common, and are wonderfully bright-colored with red, blue, green, and purple. Some species occur in the north, and the common sea-robin is found along the New England coast. The sea-robins are closely related to the common sculpin, and, like the latter, have large, goggle eyes and hideous heads and mouths. They are not considered good eating in the north, but in the tropics the people are very fond of them.

There are also a number of other species of fish that have fins so winglike and that move about in such a graceful manner, waving the broad fins very like a butterfly's wings, that they seem to fly rather than swim. Such

are the angel-fish and butterfly-fish — beautiful, brightly colored creatures that are common in the tropics.

The fish that walk are very different from any of those that fly, for, whereas the flying-fish have their fins developed into wings, the walking-fish have gone as far in the opposite direction and have transformed their fins into feet. Several walking-fish never venture from their native element, but crawl about upon the bottom of the sea or among the seaweeds and other marine growths. Some of these, known as blennies, are much like the sculpin in appearance, except for the fins, and they have such huge eyes and wide mouths that they look for all the world like some sort of submarine toad. Another fish that can both walk and swim with equal facility is the bat-fish, a curious creature found on our Southern coast and in the tropics (Fig. 2).

The oddest of all our American walking-fish, however, is the mouse-fish, or Gulf-Stream fish. These curious chaps are so stumpy and misshapen as to look like freaks or monstrosities. Their eyes gaze skyward, their mouths are turned up, they are humpbacked and pot-bellied, and their fins are turned backward and end in regular toes or fingers.

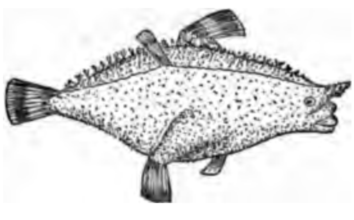

Fig. 2

They are oddly colored, in dull browns and yellows, and are ornamented with queer, leaflike or ribbonlike appendages. The color and these streamers are of great value to the fish, for he lives only among the floating gulfweed,

or sargassum, of the Gulf Stream. Among these floating seaweeds the fish lives, and rears its young in nests made among the weed (Fig. 3). The color and appendages look so much like the weed where he lives that it is almost im-

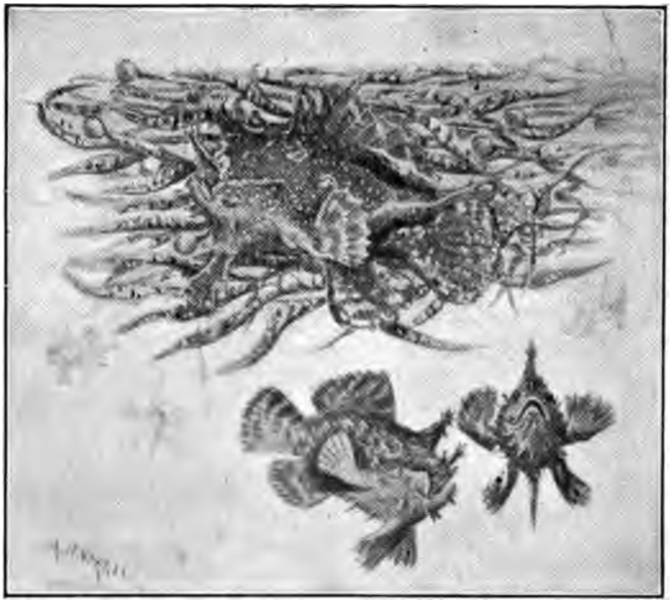

Fig. 3

possible to see the little creature, who is always playing the game of "nature's hide-and-seek." Although this gulfweed fish can swim quite well, he prefers to walk, and crawls about the floating weed in a slow, deliberate manner, more like some small quadruped than a fish.

The true walking-fishes are even more remarkable, for they

not only swim and walk about under water, but actually leave their liquid homes and crawl about on land, and even climb trees! They are called gobies, and are much like the blennies in appearance, and live in southern countries. They often crawl out of water in large numbers and jump about and play like troops of kittens. Along the bays and rivers where they live there are many low trees, and up these the walking-fish climb in search of their food. Think what a queer sight it must be to see a school of goggle-eyed fish hopping and walking about on land and climbing up trees like land-animals (Fig. 4).

Another fresh-water fish of India, known as the anabas, not only climbs trees and walks about on land, but also migrates long distances over hills and plains from one watercourse or lake to another. These creatures climb and walk by means of stiff spines on the cover, or opercula, of the gills, and they are also remarkable for having a peculiar series of chambers, or labyrinths, within the head where water is stored to breathe while the fish are traveling overland.

In the rivers of South America are certain species of catfish that travel about on land and move so rapidly through the grass that Professor Agassiz was deceived into thinking them some species of small mammal. When the rivers wherein these catfish dwell flow over their banks and flood the surrounding forests these peculiar fellows have a remarkable habit of hunting the white wood-ants which live in nests in the tree-tops.

Just imagine catfish attempting to rob ants' nests fifty or more feet above the ground! The fish succeed, nevertheless, and go about it in the following manner: a number

of the catfish gather about a tree where the ants live, and one or two of them at once begin to climb up the tree-trunk. They progress quite rapidly, and as soon as they reach the nest commence to devour the ants greedily. Of course, large numbers of the insects drop or are knocked off and fall to the water below, and here the fish, lying in wait for this very purpose, make short work of the unfortunate ants. Some kinds of fish also have wonderful powers of remaining out of water for a long time. These generally live in muddy

Fig. 4

Fig. 5

streams that dry up in summer, and at such times they bury themselves in the mud and dry up like their surroundings.

In this condition they can remain for a very long time without the slightest harm, and if taken out and placed in water they swim about as happy as ever.

There are two kinds of these odd fish, which are much alike

in appearance but live in widely separated localities—one, known as the lepidosiren (Fig. 5), is found in Brazil, while the other, called doko, is found in tropical Africa.

They are long, slender, eel-like creatures, whose fins are arranged in pairs near the head and tail, and these fins are so slender and look so much like legs that the fish looks far more like a salamander, or a lizard than a real fish.

The most remarkable thing about them, however, is that they have both gills and lungs. With the gills they breathe while in the water, and when the water has disappeared and they are living in their earth homes they depend on their lungs.

Sometimes the balls of hard, dry earth or mud containing these strange fish are sent to Europe or America, and when placed in an aquarium the fish come forth as lively as if they had been in water all the time instead of having been sealed up in clay for several months.

Part V

MAMMALS

[redacted]

Chapter XVI

TRAPPING AND HUNTING

MAMMALS are a very difficult group of specimens to prepare, but they are the most attractive to many boys, and when well mounted are very valuable. The number of species of mammals found in any one locality is not very great, but as all the fur-bearing animals are rather hard to secure and are very difficult to mount properly, it will probably take a long while to make your mammal collection anywhere near complete.

You should always begin the mammal collection with small species such as squirrels, gophers, weasels, etc., as these are quite easy to obtain and are comparatively easy to mount. If in the mean time larger things, such as foxes, wolves, coons, deer, etc., are obtained, they may be merely skinned and placed in brine, and then dried until you are proficient enough in taxidermy to undertake the work of mounting them.

In order to obtain your mammal specimens you will have to hunt and trap, and nearly every boy is fond of these occupations. If you are not already familiar with trapping,

you had better get some one who is to show you the various little "wrinkles" that make trapping successful, and without which your attempts will prove failures. I will, however, try to give you a few hints in regard to traps and methods which may help you to catch many of the commoner and more unsuspicious animals.

Squirrels, mice, rabbits, skunks, and many other small animals may often be obtained by using box-traps similar to the one shown in Fig. 1. These are easily constructed of rough wood, and should be set where the animals are

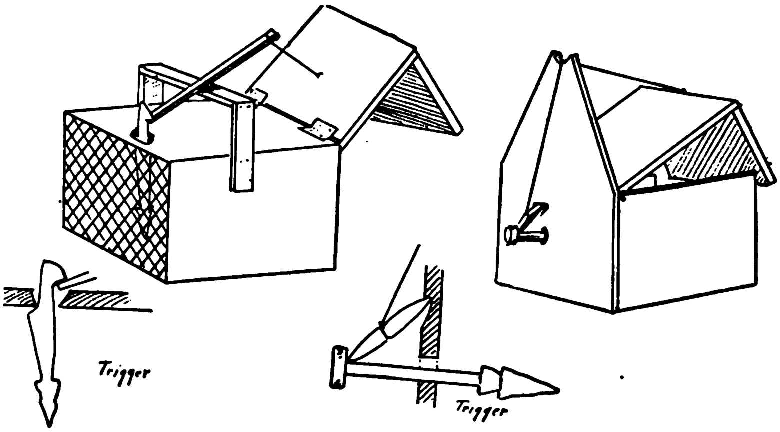

Fig. 1

common, and are baited with corn, fruits, vegetables, or meat, in accordance with the natural food of the creatures you are trying to catch.

For small mammals, such as wild mice, wild rats, ground-squirrels, shrews, etc., the spring rat traps sold for catching

house mice and rats are excellent. A large number of these should be set in woods, fields, and meadows, and you will probably be greatly surprised at the number and variety of small animals that you will obtain in this way. Most of the mammals are shy, night-prowling creatures, and are seldom seen alive, but if you tramp through the woods and fields after a light fall of snow you will find dozens and scores of tracks of these animals crossing and recrossing in every direction.

For the larger animals steel traps should be used, and great care should be taken to set these carefully and to handle them just as little as possible.

A good plan is to wash your traps thoroughly in weak lye and water, and then grease them thoroughly with chicken or goose fat. To destroy any human scent, traps are usually smoked over a wood fire. After the traps are washed you should always wear gloves in handling them, as nothing will make a wild animal more suspicious than the smell of a human being on a trap.

Chicken or rabbit manure scattered around the trap when setting it will frequently prove very useful in destroying the odor of your presence, and, moreover, will frequently serve to attract wild animals. In setting the traps you must proceed in different ways for different kinds of animals, but in all cases make sure that the chain is as thoroughly hidden and that it is as carefully cleaned and greased and free from handling as the trap itself. When traps are set on land, the end of the chain should be fastened to a short, heavy log or "drag" that will prevent the captured animal from traveling far or rapidly, and will also leave a good, plain

trail; if the trap is fastened to a tree or a rock, the animal will usually tear himself free or will gnaw off a leg or a foot to escape. When setting steel traps for water-animals, such as mink, muskrat, or otter, it is a good plan to fasten the chain to a strong wire, one end of which is fastened on shore and the other to a stake driven into the bottom of the brook or pond, or to a heavy rock thrown into the water. If the chain slips easily along the wire the struggles of the captured animal will cause it to run down beneath the water and drown the creature. Meat, fish, chicken or turkey heads, small game, and similar things are all excellent for bait, but the bait should always be hung a short distance above the trap so that the animal will be compelled to step on the trap when trying to reach the bait. Very few wild animals will step onto a dry twig or branch, and wary creatures like foxes and mink may sometimes be induced to step into the trap by placing a small dry branch just in front of the trap and at such a distance that the approaching animal in attempting to avoid the twig will step on the trap.

Unless animals are very common in your vicinity and have never been trapped or hunted to any great extent, you will have to make trails or "scents" to lure them to the traps. To do this you should fasten a bloody piece of meat or a freshly cut chicken's head to a stick and smear it over with fish-oil, oil of anise, or some similar strong-smelling oil, which is then dragged over the ground in various directions to the trap, so that any animal approaching the vicinity will smell the odor and will follow it up to the bait.

Trapping should be carried on in winter as much as possible, for at that season the skins and fur are in the best condi-

tion; but as you will want to show some species in both summer and winter coats, you will have to do some trapping in warm weather also. Weasels and ermine are brown in summer and white in winter, as are also various hares; and the mink, martin, sable, and many other animals have a coat much darker and richer in cold weather than in warm weather. In winter you do not need to visit your steel traps every day, but in summer-time it is best to do so, as otherwise your captives will get heated and the hair will fall out. Small traps set for mice, etc., should be visited every day both winter and summer, as otherwise the various larger animals and crows will devour the animals caught before you find them.

Deadfalls may also be constructed by boys familiar with trapping, but, as a rule, you can get more and better specimens in steel traps than in any other kind. When setting traps for mink, muskrat, otter, etc., the trap should be set on a log or stone in the water, or even under water close to the shore. Traps set in very shallow water with a chicken head or fish head suspended above will often catch mink and otter when all other methods fail.

When your animals are caught and found, do *not* strike them on the head if you wish to preserve them for mounting, as the *entire* skull must be used in mounting them. It is far better to pin them down with a stick and chloroform them. If this is not possible you may kill them by a sharp, hard blow across the back; skunks may be killed in this way without giving them an opportunity to produce any odor.

In the case of larger animals, such as coons, foxes, wild-cats, etc., the best method is either to shoot them or to stun

them with a blow on the head, being careful not to break the skull; as soon as they are stunned you may kill them with chloroform.

Although animals killed by shooting are inferior for their hides for furriers' use, yet for your specimens they are just as good as trapped animals; and frequently weasels, musk-rats, woodchucks, and foxes may be shot, while squirrels and rabbits may always be obtained in this way. Some kinds of animals live in holes or burrows and sleep or hibernate through the winter months. This is the case with bears, woodchucks, and prairie-dogs, while many species of squirrels are quite sluggish in very cold weather. If you find a hollow tree or stump, it is always a good plan to look or feel within, for some small animal or an owl may have made his home there. Flying-squirrels (Fig. 2) are very pretty and interesting creatures, and are very difficult to obtain, unless you find their nests or holes. Like many of the other squirrels, they build nests in trees as well as in holes, and their presence may usually be known by bits of stripped cedar bark, leaves, and moss projecting from the hole or cracks near it. Many wild mice also live in holes in trees, and other species make their homes in deserted birds' nests and squirrels' nests. Some of these mice are very dainty and pretty creatures, and make very attractive museum specimens (Fig. 3).

Moles and shrews live either in burrows or beneath old logs and rocks, and while shrews may often be caught in spring mouse traps, the moles must be caught in mole traps or dug out from their holes. Moles are very easy to skin and mount; but as there are very few species, and as they

are very shapeless, uninteresting things (Fig. 4) they are not of so much importance as their cousins the shrews (Fig. 5). Sometimes cats bring in many shrews and moles, and if you live near woods or meadows and find your cat

Fig. 2

Fig. 4

Fig. 5

Fig. 3

prowling about you had best watch carefully and secure any small creatures that she captures.

Bats are very important members of the mammal col-

lection, for there are numerous species, and few people ever know what they really look like until they have an opportunity to see museum specimens.

Some kinds of bats, such as the common red bat, may often be found hanging head down to a branch or twig in the woods, but as a rule they are found during the day hanging to boards or timbers in belfrys, back of loose clapboards on barns and buildings, in caves or hollow trees, and in similar situations. Bats may also be collected by shooting them with a shotgun at evening, but this is difficult work, as they are very erratic in flight, and the twilight makes shooting uncertain.

Chapter XVII

ANIMAL HOMES FOR THE MUSEUM

MANY homes of wild animals are very interesting to have in your collection, and the nests of wild mice and squirrels should always be shown. These are just as easy to collect and prepare as birds' nests, but homes in hollow trees or in the earth are much harder to secure. Of course, with care and patience the burrows may be dug out entire, or whole trees cut down and carried home; but, while these methods answer very well for large museums, they are not to be recommended for amateurs. By keeping your eyes open, however, you can usually find some squirrel's hole in a small limb or dead stump, and this can be taken to the museum and set up on a stand, with mounted squirrels in natural attitudes about it. If the hole is cut open and shown in section, with the bedding of torn cedar bark and nuts at the bottom, it will be doubly interesting.

Holes in the earth or in the banks of streams may be treated in a very different manner. If you find a fresh nest of a muskrat or chipmunk, you can reproduce its features perfectly in your museum by the following method.

We will suppose that you decide to show the home of a

ground-squirrel or chipmunk; and as these little chaps have very interesting habits and underground burrows, they should be illustrated in your collection, as well as the animals themselves. Mark the hole of the chipmunk by placing a stick in the entrance, and then search all about for another hole, for chipmunks have two entrances to their holes—a front and a back door, so to speak—and the rear entrance is usually very carefully concealed beneath or beside a rock, stump, or tree, and at times even opens within a hollow stump. After you find this rear entrance mark it as you did the front door, and note which side of the line between the two sticks is the lower. Then about two feet distant from an imaginary line between the two entrances of the burrow commence to dig away the earth by digging a steep-sided trench as long as the distance between the two holes.

Throw all the earth away from the burrow, as you must try and retain the natural surroundings over the hole as perfectly as possible. When the trench is about two feet deep, dig carefully toward the first hole, and keep the side of the trench almost perpendicular. In this way, and by slicing off thin layers of the sides and throwing it out, you will be able to reach the hole without disturbing the surrounding earth to any great extent. As soon as the section of the hole appears take a trowel or small shovel and carefully dig away the earth from the entrance in the direction the hole extends so that half of the hole remains intact in the bank of earth you have left. By careful work you will thus be able to expose the entire hole, and presently it will lead you to an enlarged underground chamber or "room," which

will probably be partly filled with soft leaves, nutshells, and bits of moss (Fig. 1, B). Do not disturb this chamber, which is the front room, or "parlor," of our little friend. Continue digging a short distance, and another enlarged chamber will be exposed which will be packed full of leaves, soft bark, moss, and dried ferns. This is the bedroom of Mr. Chipmunk, and is shown in Fig. 1 at C. Continue digging along toward the rear entrance of the burrow, and pretty soon you will find another chamber, the largest of all, and if your ground-squirrel has been at all thrifty you will find this storeroom, or "pantry," nearly filled with nuts, corn, roots, and all sorts of provisions (Fig. 1, D). Leaving these rooms undisturbed, you should continue digging, following the curve of the hole toward the back door, until the surface of the ground is again reached, and you will find that you have a splendid section of the chipmunk's home exposed to view (Fig. 2). You should now carefully sketch in all the details of the hole, the proportions and arrangement of the several rooms, the surroundings and all other points, and should carefully measure the depth of the hole and chambers from the surface of the earth at various points. In fact, make sketches and measurements that will enable you to build an exact duplicate of the entire burrow when you get back to your workshop. If you have a camera you can take a photograph of the section, and this will be a far better guide than the sketches, but rough outlines with the various measurements are necessary.

After all your notes are complete remove the contents of each chamber entire and wrap each separately in a piece of cloth or paper, and mark each package to correspond

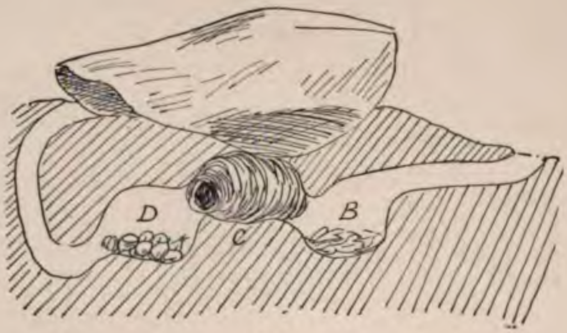

Fig. 1

Fig. 2

SECTIONS OF CHIPMUNK BURROW

with the sketches you have made. Save any rocks or dead branches or bits of bark or stumps that may be on the ground over the hole, as well as any roots that project from the earth where dug away, and carry everything home, leaving the hole of the animal as nearly intact as practicable.

When you are ready to prepare the artificial burrow, you must obtain a wooden stand, or platform, a little longer than the entire distance from one hole to the other and about a foot wide, and to this securely fasten ends and back as high as the top of the earth to the bottom of your excavation. Now, by using rough laths, wire netting, old canvas, and a little ingenuity, build a rough outline of the bank inside your wooden frame, but slightly smaller in all its dimensions than the original bank. On this support plaster paper-pulp, plaster of Paris, and clay until the general shape and character of your excavation and the surrounding earth is obtained. All that is now necessary is to model the shape and proper size of the chipmunk's hole and rooms and cover your paper bank and surroundings with leaves, sand, rocks, bushes, etc., in as exact an imitation as you can arrange of the original hole and its surroundings. This need not all be done at one time, for you can work on it just as well at odd moments, and frequent visits to the chipmunk's home may be necessary in order more closely to imitate certain features that have been overlooked or obtain accessories that are difficult to imitate. There is no doubt that to reconstruct perfectly an underground nest in this way entails a great deal of trouble, time, and patience, but if your work is well done the final result will astonish your friends

and interest your visitors, and will be a noteworthy addition to the museum, in which you may well take pride. If the chipmunks themselves are mounted on the same stand near the nest it will add still more to the appearance of the whole, and will serve the dual purpose of illustrating the animals themselves and their home life.

Chapter XVIII

MOUNTED MAMMALS

THE greater portion of your space devoted to mammals should be occupied by well-mounted animals, and unless you really intend to take an interest in this group and learn how to prepare and mount them properly you had better not include mammals in your museum at all.

If you have not the time, skill, or means to learn animal taxidermy thoroughly you may still show the smaller species, for these are very easy to mount and are far less known to most people than the larger species.

Any boy with patience, perseverance, and common sense can learn to mount any mammal not larger than a deer or bear by following the directions given, and a well-mounted mammal always adds a great deal to any collection. Another great advantage in being able to mount birds and animals is that you may often get good prices for mounting pets or game for your friends, and the money thus obtained may be well invested by purchasing supplies, tools, cases, and other necessary things for your museum. A few years ago all mammals were merely "stuffed" with excelsior, straw, tow, or some similar substance rammed in around a framework of wire, steel rods, boards, and nails, and most

specimens prepared in that way were perfect monstrosities.

Nowadays expert taxidermists build a perfectly modeled and accurately measured body of clay, paper, plaster, and similar materials and fasten the prepared skin over it so that the finished mount shows every muscle and wrinkle found in the living creature, the whole forming an almost indestructible and very enduring specimen, for it is in reality a true statue of the animal covered with tanned skin.

If you intend to make a special feature of your mammal collection you should spend a great deal of time and practice in this line of work, but for your ordinary purposes a method about half-way between the old-fashioned "stuffing" process and the up-to-date modeling process should be followed.

For the preparation of your animal specimens you will require a few tools, preparations, and appliances in addition to those used in skinning and mounting birds and reptiles.

The first thing to prepare is the brine, or tanning solution, for all skins intended for mounting must be pickled in this, except the very smallest species, and even these are improved by the process. Each taxidermist has his favorite "pickle," but they nearly all consist of salt, alum, and water in varying proportions, sometimes with tanning or other substances added.

A very good solution can be made in the following proportions: 2 lbs. common salt, ½ lb. powdered alum, ¼ lb. saltpeter in 5 gals. water.

By adding a solution of one ounce of sulphuric acid in four quarts of water to this preparation a better brine will be obtained.

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Just as soon as an animal is skinned and the excess flesh and fat scraped off, the skin should be placed in this mixture, frequently turned over and around, and left for several days, as described farther on.

For skinning your mammals the same tools used in skinning birds may be used, but in addition you will want some large scalpels, or a regular skinning-knife, a pair of bone-cutters or a pair of tinsmith's "snips," some wire-netting of various sizes, some soft iron rods 1-8 in., 5-16 in., and 3-8 in. in diameter, as well as papier-mâché, potter's clay, surgeon's needles, and plenty of stout string and coarse linen thread.

All these things will not be needed for the usual run of small mammals, and as the skins, after pickling, may be dried and kept indefinitely until ready to mount, you need not get the supplies until they are actually required.

The first step in preparing a mammal is to skin it, and after you get accustomed to this work you will find it very easy.

Make an incision from the chin to the base of the tail along the belly, being very careful not to cut through the abdominal walls and parting the hair carefully as you cut, for if the hair itself is cut it will be very hard to hide it in the finished specimen.

Join this first cut by cuts down the inner side of each leg to the ankle joint (the last joint next to the foot) (Fig. 1), and proceed to work off the skin from the flesh. The skin of mammals sticks to the flesh a great deal harder than that of birds, but by pushing away the flesh from the hide and by cutting with the scalpel and knife where it adheres the most

you will be able to proceed very rapidly. Skin down each side of the neck, chest, and belly as far as possible, and use plenty of fine sawdust or corn meal as you work. When the shoulder and hip joints are reached amputate them close to the body by cutting through the tendons that hold

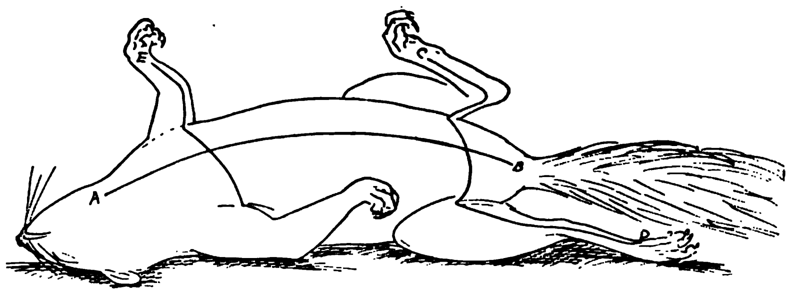

Fig. 1

Fig. 2

the bones together, but do not break or cut the bones themselves unless they are injured or fractured by shots or other injuries.

When the base of the tail is reached it should be cut through with the bone-cutters or snips, and you will then find that the whole hide can be stripped quickly off down to the head, leaving the tail and four feet and legs with flesh and bones in place (Fig. 2). Continue skinning down the

neck until the base of the skull is exposed, and then proceed very carefully until the ears are reached. Here you must use every care not to cut through the skin of the ear, but must dig and cut deep in the ear cavity until the ears are free. The eyes will next be reached, and these should also be worked on slowly and patiently, much as in skinning a bird, until the lids are free and the skin slips readily down to the lips and nose. Cut along the edges of the lips where they join the flesh, and cut the cartilage that attaches the nose to the skull, and the entire hide will then slip off.

Then skin down each leg until the foot and toes are reached. If the animal is smaller than a fox you will not need to skin the toes, but in large mammals every particle of meat and fat *must* be skinned out from the toes and pads, and the bones left attached to the skin only at the very tip of the toes or at the hoofs. Before removing any of the flesh from the legs you should make a sketch of one front and one hind leg showing the shape and arrangement of the muscles and cords, and should jot down the measurements across the legs at various points as well as the girth around them. Fig. 3 shows how the sketches should look with measurements marked down.

Having done this, you may proceed to cut and clean off all the flesh, fat, cords, gristle, and tendons adhering to the leg-bones, but do *not* separate the joints, but leave them as shown in Fig. 4. Skin the tail by pulling on the severed root of the bone and by cutting the tendons that hold the skin to it. After skinning it a short distance you can probably strip the skin off the tail by holding a piece of hard wood or a split stick on each side of the bone and pulling

on the latter (Fig. 5). This is an easy way to skin the tails of most small and medium-sized mammals, but large mammals must have the tail skinned by cutting a slit on the lower side and treating it like the legs or body. The tail having been skinned, the next step is to carefully cut away all adhering flesh and fat from the lips, ears, and eyelids, and skin the ears. If your specimen is a rodent you will have little trouble with the lips, but if it is a carnivorous creature of the dog or cat family, such as a wildcat, fox, wolf, or coon, you will be obliged to use a great deal of care and skill in cutting away the flesh and still retaining the inner and outer folds of the lips and cheeks uninjured. Squirrels, mice, weasels, and similar small animals do not require to have the ears skinned, but larger species, as well as rabbits and hares, must be skinned, or else the finished specimen will have shrunken and distorted ears that will ruin its appearance.

It is not difficult to skin the ears, but it requires time, and it is a process impossible to describe; the only thing is to use care, common sense, and judgment, and work away until you get out all the flesh and cartilage is removed.

Now scrape and cut all bits of flesh and fat from the inside of the skin, and place it in your brine. When first placing it in the brine it should be slopped back and forth and round about until sure that every part has been wet thoroughly, and it should then be forced beneath the surface and held there by a stick or prop pushed down onto it and braced against some object above. After ten or twelve hours the moving and stirring about should be repeated, and the skin should remain in soak for from one to ten days,

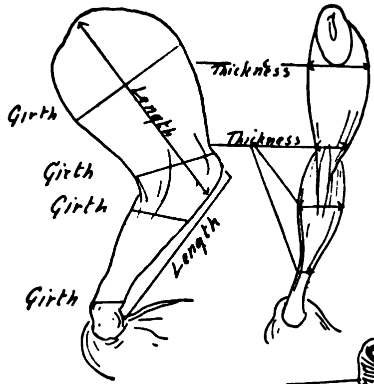

Fig. 3

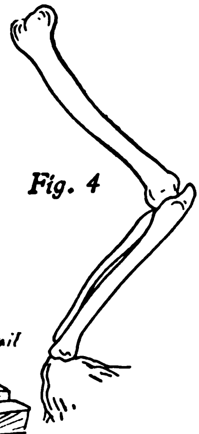
Fig. 4

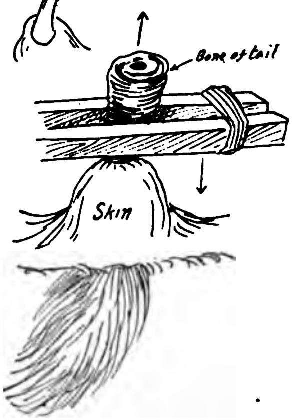

Fig. 5

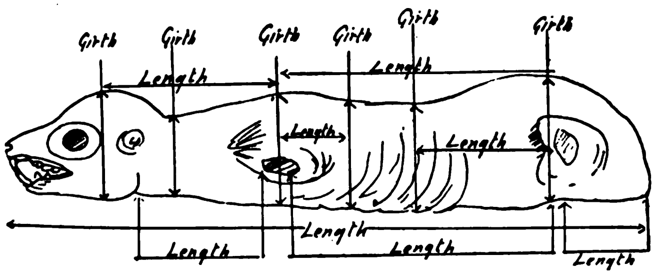

Fig. 6

SKINNING A MAMMAL

according to the size of the animal and the weight and thickness of the hide. If the skin is not to be mounted at once it should be drained free from the brine, rinsed in fresh water, and hung up until partly dry in a cool, shady spot. It may then be sprinkled with coarse salt, folded or rolled with the hair side in, and dried, and may be stored away until wanted. It may be softened and mounted at any time by merely soaking in fresh water for several hours.

As soon as the skin is placed in the brine take note-book and pencil and a tape-measure and make accurate measurements of the carcass as follows:

Length from tip of nose to base of tail along line of back; length from nose to base of tail along lower side; girth at base of skull; girth at base of neck; girth at shoulder; girth at widest part of chest; girth at middle of abdomen; girth just in front of hind legs; width across buttocks from hip-joint to hip-joint under tail; width across chest beneath neck from shoulder-joint to shoulder-joint. Length of bone of tail; girth of tail-bone with flesh at base. Make a rough sketch of the carcass, marking the various points of measurements, and indicate the various muscles by outlines (Fig. 6). Also place the body and neck in something like the attitude you have decided to mount the specimen, and note the position that the muscles assume. When you are sure that you have taken these various observations carefully, you may sever the skull from the neck at the base, but be careful not to cut or break the skull.

Chapter XIX

HOW TO MOUNT A MAMMAL

IF your specimen is to be mounted right away you may leave out the measurements as above described and keep the carcass for reference until the animal is mounted, and then measure it as you proceed to make the false body. In very small animals, such as squirrels, mice, bats, etc., it is not necessary to make all these measurements, and the skin may be cut only from the base of tail to base of neck, and the latter be turned inside out over the head and legs, exactly as described for skinning birds. Deers and other horned animals must have the skin cut across between the horns and back between the ears and down on the back of neck for a short distance, to allow the skin to come off from around the horns.

If you wish to preserve the skull of your animal for a separate exhibit in your museum, you may make a cast of the one just taken from the skin, using clay and plaster of Paris just as you did for casting reptiles, fish, etc. From the mold thus made you can reproduce the skull with its muscles, tendons, etc., in paper or plaster, and can then clean the real skull and use it in your collection. A commoner and better way is to carefully clean the skull of all

flesh, fat, brains, and sinew by scraping and cutting, after first making careful sketches to show the positions of the muscles, their shapes and sizes, and when all animal matter is removed soak the skull in fairly strong washing-soda for several hours, scrub it off, and place it in the pickle with the skin.

The next step is to prepare the body, or manikin, and if the creature you have selected to work on is smaller than a fox (for convenience we will suppose the animal to be a gray squirrel) you should proceed as follows.

Take a piece of soft iron wire or small iron rod about one and one-half times as long as the entire body, neck, and tail of the animal, and twist two loops or rings in it, one as far from one end of the wire as the hip-joint in the carcass is from the tip of the tail, and the other the same distance from the first as the shoulder was from the hip in the real animal's body (Fig. 1). Cut four more wires of the same size and each about twice as long as the animal's legs. Sharpen one end of each wire to a needle-point and pass the blunt end of one wire through one of the rings in the back wire. Twist the end round the back wire for several turns (Fig. 2), and then run another one of your wires through the same ring from the opposite side, and twist this tightly around the back wire and around the first wire as well (Fig. 3). Do the same with the other two wires through the other loop, and the resulting skeleton will appear as in Fig. 4. Next wrap tow or excelsior around the back wire and out along the tail wire (Fig. 4, T), and wind it evenly and as tightly as possible with strong thread, but be careful to keep the *largest* part of the body and neck no

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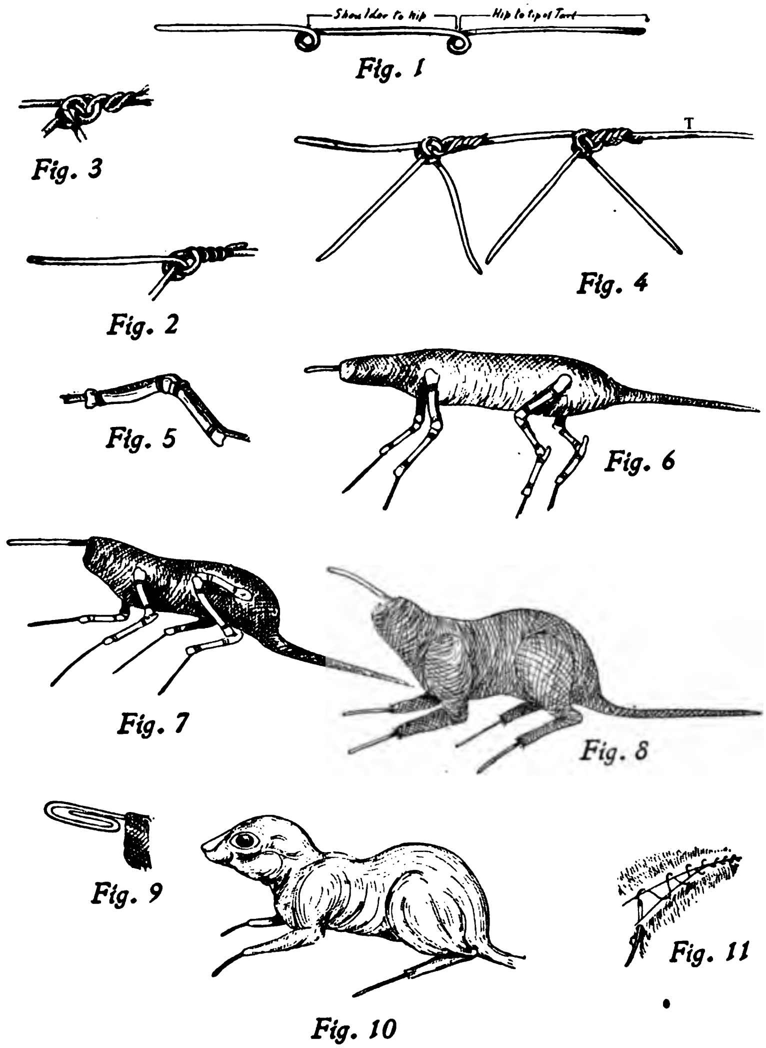

HOW TO MOUNT A MAMMAL

greater in girth than the *smallest* part of the real neck and flanks as shown by the measurements you made.

Lift the hide from the pickle and carefully separate the right fore leg from the foot at the ankle-joint by merely cutting through the membrane of the joint. Place this leg-bone along the wire that corresponds to the right fore leg so the wire is along the backside of the bone, and tie it in place by fine threads wrapped around it above and below each joint (Fig. 5). Do the same with the opposite front leg and with each hind leg in turn.

The frame will now look like Fig. 6. The backbone of wire and leg wires should now be bent into the proper curves for the attitude selected for the mounted specimen, and will then appear like Fig. 7. The foundation of the body and legs should now be carefully padded and added to, by bits of tow and excelsior wound in place, until they are of exactly the same shape and dimensions as the original flesh, as shown by your notes and sketches (Fig. 8). You should now measure carefully from the fore shoulder along the back of the neck and cut off the end of the backbone wire an inch or two longer than required. Bend the end of this wire into a loop (Fig. 9), and insert this in the cavity of the skull where the brains were, and secure it in position by pouring in plaster of Paris. Place the whole away to harden, and while the plaster is hardening you can prepare the pickled hide.

Drain the hide and rinse in clean, fresh water and squeeze out all the surplus from hide and fur. Rub and pull it gently about until free from all wrinkles, folds, and creases, and spread it skin side down on a sloping board and rub

it with sawdust or corn meal until the hair is fluffy and almost dry.

By this time the plaster in the skull will be hard, and while the skin is drying you may occupy your time by modeling clay onto the skull to represent the flesh on the cheeks, roof of mouth, lips, ears, and in the eye sockets and around base of skull. At this time you should also insert the glass eyes in their clay-filled sockets and try to get the clay-covered skull just as much like the original flesh-covered skull as possible, and be very sure that both sides are alike and perfectly symmetrical. Build up with tow around the joint between neck and head, and finally smooth on a layer of rather soft clay over the entire false body, which will now appear like Fig. 10. Lift up the partly dried skin and force each of the leg wires out through the soles of the feet *from the inside*, and slip the tail on over the artificial tail. The skin of legs, body, neck, and head should now be drawn into position, and by working carefully and pulling here and rubbing there the skin will fit like a glove, provided the artificial body has been properly and carefully made. When it has been fitted in place to your satisfaction you may sew up all the cuts in the skin; commencing at the chin and sewing down to the front legs, sew up the belly, and, last, the legs, and while sewing use an under-and-over stitch as shown in Fig. 11 and a curved furrier's or surgeon's needle, and be very careful indeed not to draw any fur or hair into the stitches or under the threads; if you should happen to draw any in you must work it out at once by a needle-point or fine forceps. When all the cuts are sewed up the skin should be pressed and smoothed into place on

the body, and as it will adhere firmly to the clay covering on the manikin you can model it into wrinkles, creases, and natural folds very easily. The animal should now be fastened to its stand or other mount; and while it is advisable to place the specimen directly on its final mount, this is not imperative, for when dry it can be easily changed from a temporary to a permanent stand. Fasten the wires to the limb or branch selected by running the wires from the legs through holes bored in the mount, and bend them over to secure them in position.

Bend the tail up in a natural attitude, smooth up and arrange the position of the legs and neck, and when the body, legs, and tail are about correct turn your attention to the head. The lips should be carefully pressed into place against the clay beneath and secured by fine pins run through the inside of the lips so that the holes will not be visible in the finished specimen. Model the eyelids in a natural way around the artificial eyes, smooth out the "whiskers," work the ears into position by pressing and pulling at their bases, and then go over the entire animal and brush and comb his fur into a smooth, even coat. If it has a tendency to stand up or become rough in spots it may be dampened with a little starch and water, which can be easily removed when dry. Arrange the claws and toes and secure them in place by pins placed around them, and finally run pins down inside the ears to hold them in place. When you have done all you can to make your specimen appear as natural and lifelike as possible set it away to dry, and do not disturb it until thoroughly dry and hard. This can be determined by carefully testing one of the toes

or feet. When these are thoroughly dry and stiff you can be sure the whole animal is dry. It is a good plan, however, to look it over once in a while, so that if any part of the fur roughens up in drying it may be smoothed down and secured by starch or thin flour paste.

When completely dry clip off any projecting wires, pull out the pins about the toes and ears, cut off the pins in the

Fig. 12

lips close to the skin, and comb out the hair and beat lightly with a thin, flexible strip of rattan or whalebone, and your handiwork should then appear as in Fig. 12.

In these directions I have not mentioned poisoning the skin, for a well-pickled skin will seldom be attacked by

moths, but in order to be absolutely proof against insect pests the skins should always be soaked in a solution of arseniate of potash for a few minutes just before mounting, or they may be brushed over with the solution just before placing on the manikin. Arseniate of potash is very dangerous, however, and I do not recommend its use for young naturalists.

Arsenical soap may be painted over the inside of the skins, or powdered arsenic brushed over them as in preparing bird skins, in place of using the arseniate of potash, but in every case where arsenic in any form is used every precaution should be taken to prevent it from being scattered about, and every bottle or box containing it should always be plainly labeled with "Poison" and skull and bones. Probably arsenical soap is the safest preparation for using arsenic for natural-history work, as in this form it is an unattractive-looking mess and not likely to be mistaken for anything else.

Chapter XX

MOUNTING A LARGE MAMMAL

IF you succeed well in mounting your squirrel you may try something larger, such as a coon, fox, or wildcat. For practice, a young goat or some other domestic animal is excellent; but foxes, coons, or wildcats are all good subjects, and if the first attempt is unsuccessful the skin may easily be softened up and a second attempt made. In fact, one great advantage that mammals have over birds is that you can mount and unmount them over and over again without injury until you are satisfied with the results of your efforts.

Moreover, if you cannot finish mounting an animal at one sitting you can wrap it up in damp cloths and keep the skin soft and flexible until you get an opportunity to complete the work. Such cloths should have some formaline sprinkled over them, or should be dampened in water to which a little formaline is added, to prevent the skin or hair from molding or becoming mildewed.

To skin a large animal proceed exactly as already directed for the smaller species, and treat the hide in the same way, but in skinning the legs carry the cut clear to the sole of the foot and scrape and dig out all flesh and gristle around the

small bones. As the leg-bones are clumsy and bulky, however, they should be separated from the toes or ankles before placing the skin in the brine, and each leg should be marked with a tag stating that it is the "right front leg," "left hind leg," etc., and if you have more than one skin on hand the tag should also bear a name and number corresponding with a similar label on the skin and another on the skull. The leg-bones should be treated with brine in order to cure any animal matter adhering to them, and may remain in the pickle until ready to use, but should be rinsed in fresh water before mounting, in order to remove any excess salt, which otherwise will rust the wires and prevent the joints from drying out after mounting.

In making the body, or manikin, for a good-sized animal stout rods of iron must be set into the stand and fastened securely by threading the ends and using nuts and washers. These rods should be wired, or wound, to the leg-bones above and below each joint and should then be bent into the proper position by bending at each joint (Fig. 1). For the backbone and body foundation cut a piece of spruce or pine plank into a rough body shape, but keep it quite a little shorter and narrower than the real body. Fasten the four rods to this plank very firmly by bolting or screwing them in place (Fig. 2), and be sure that they are the proper distances apart at shoulders and hips. This distance can be obtained by nailing blocks of the right thickness to the body plank, and attaching the rods to these (Fig. 3). For the neck you must use either a stout iron rod fastened securely to the back of the body plank or another piece of wood of the proper length for the neck; and the skull must be fastened very

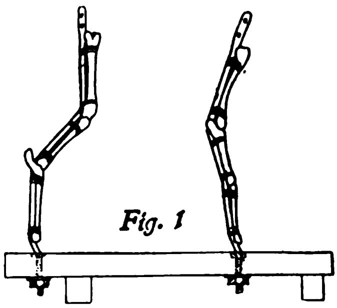

Fig. 1

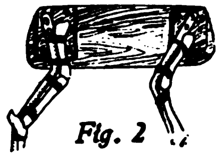

Fig. 2

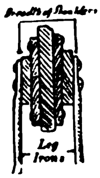

Fig. 3

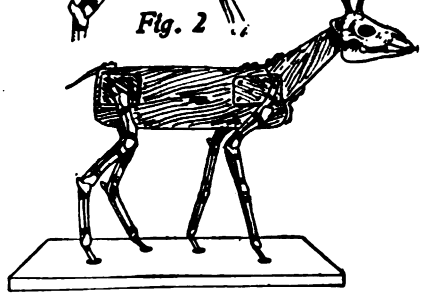

Fig. 4

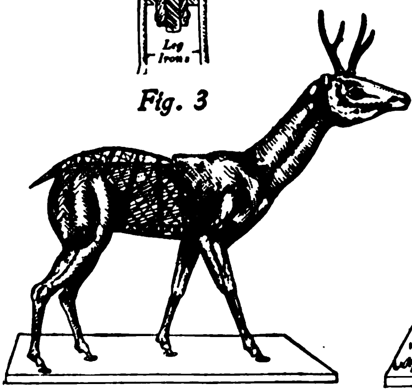

Fig. 5

Fig. 6

firmly to this artificial neck, or the finished animal will never be satisfactory. If a wooden neck is used, the skull may be fastened to it by screws through the back part of skull; or if an iron rod is used it may be fastened inside the head with plaster, and the skull wired firmly to the neck as well. The

completed frame and skull should appear as in Fig. 4. The next step is to build out the body, neck, legs, and skull to represent the flesh and muscles, and the method of doing this depends largely upon the size of the animal. Any creature smaller than a deer can be built up by winding on excelsior and tow and sewing through where the hollows between muscles appear, but in deer and all larger animals it is better to build out the body by nailing on a rough support of wire netting and modeling the artificial muscles with papier mâché. This is merely paper-pulp, and may be obtained from any paper-mill or from any dealer in naturalists' supplies. It can be made by boiling torn-up blotting-paper or newspaper in water and adding glue or paste, but the home-made product is never as satisfactory as the regular pulp, and the latter is so very cheap that it does not pay to try to make it. If the pulp is not too wet or too dry, and has a little glue and whiting mixed with it, it will stick very firmly to the body frame and skull and will model into shape as readily as clay. Endeavor to shape the body and neck as accurately as you can, and make frequent measurements to be sure you are not getting any portion too large. The flesh on the legs and skull should also be represented by the paper, and if the animal is to be mounted with an open mouth the jaws should be wired in the proper position before the paper is molded around their joints. A netting-covered body, partly covered with the paper-pulp, is shown in Fig. 5, and by using a little ingenuity and care you can produce a manikin that very closely reproduces every swelling muscle on the original animal, but a knowledge of animal anatomy and keen observation of living animals

is necessary to accomplish this; photographs of live animals will also help wonderfully in showing where to model the muscles and the most lifelike attitude of various species.

When the whole body has been modeled as perfectly as possible, and the artificial eyes set in place, the entire manikin should be smeared over with clay and the skin stretched over it exactly as in the case of the squirrel. The various cuts should then be sewed up, and the skin molded firmly onto the clay-covered body, legs, and skull. Where deep hollows occur, as on the flanks and just behind the fore legs, at base of neck, etc., the skin may be brought down to the body by using pins, fine brass nails, or tacks. Never use iron or steel nails or tacks, as they will rust and stain the skin and hair. If the mouth is mounted open an artificial tongue must be made and inserted before placing the skin over the skull. Dental wax is an excellent material for modeling tongues and the inside of the mouth, but a very good tongue may also be made of wax, or if even greater accuracy is desired the real tongue may be cast in wax in exactly the same way as described for casting fish or fruits in other chapters. A great deal of care must be used in modeling around and under the nose and lips, for these parts have a great deal to do with the expression of an animal, and lips drawn together and sewed or pinned in place are an abomination. If they are molded in wax or paper and the skin pinned temporarily in place through the inner side, you can secure a very natural expression, and after drying the pins may be removed and the naked portions of lips and nose touched up with oil-colors. In mounting a large animal you will note that the leg skin is split clear down to the toes

and is slipped *around* the leg rods instead of the latter being run *through* the feet, and for this reason you must leave a short space between the bottom of the leg-bones and the base when building the frame. The length of this space is readily determined by measuring the height from sole of foot to the ankle-joint on the pickled skin.

After the mounted animal is thoroughly dried the nuts that hold the leg rods in place may be unscrewed, the animal lifted from the stand on which it was mounted, and a new stand provided in the form of an artificial rock, or a log, branch, or stump, according to the kind of animal and the position you have selected for it (Fig. 6).

Many large animals are mounted on plain wooden stands, but I strongly advise stands made as nearly like the natural surroundings of the creature as is possible. Real logs, slabs, branches, and bark-covered boards make very good stands for many animals, and artificial rocks, earth, or sand are easily constructed. Any of these things can be built up from boards, laths, and paper-pulp, and afterward coated with glue and sprinkled with lichens, moss, sand, etc.; and the boy possessing a little ingenuity and a knowledge of the haunts of wild things can produce wonderfully accurate counterfeits in this way.

Reindeer-moss or lichens ground in a mortar or coffee-mill and sprinkled on glue-coated stands give an appearance of natural moss-coated rocks and logs, and to heighten the effect bits of moss and lichen should be glued here and there. White scouring-sand gives a rocklike appearance, and common bird-gravel is excellent for imitating sandy beaches.

Scouring-sand painted over with ground umber and turpentine looks very much like brown earth, and smooth paper-pulp or a thin layer of plaster painted with lampblack and umber looks like mud; if varnish or shellac is poured here and there and allowed to collect and harden in spots and hollows, it gives the appearance of wet mud with pools of stagnant water. Shallow water is easily imitated by setting pieces of glass in the plaster or paper, and if holes are drilled in the glass and dried and colored grasses or rushes run down through them to the artificial mud beneath, the effect is still better. Glass, as a rule, is rather too transparent for real water, and the effect of turbid or partly muddy water may be obtained by coating the under side of the glass with thin white varnish or shellac tinted with umber or asphalt, or it may be merely rubbed over with brown putty until the transparency is partly destroyed. Looking-glass should *never* be used; and if deep water is wanted you should place a second glass beneath the upper one, and by coloring the lower side of this dark green, brownish, dark blue, or black, you may obtain any sort of water effect you wish. Ducks may be mounted in a swimming attitude by cutting an oval hole in the glass just the right size to admit the lower portion of their body, but you will find that cutting an oval hole without cracking the glass is a difficult matter, and it will be cheaper in the end to have it done by a professional glazier. Holes may be readily drilled in glass with an ordinary twist-drill wet with camphor dissolved in turpentine.

Ice is easily imitated by hard paraffin, and ice floating on water is made by coating the glass with paraffin and cut-

ting and cracking it away in spots, leaving the glass exposed. Snow may be made by using plaster and white paper-pulp, and scattering artificial snow—such as is used on Christmas trees—over the surface. Only a very small quantity of this is needed, as too much makes the whole look very artificial. Glass icicles can be purchased ready-made for a few cents, but very good ones can be made at home by using hard paraffin and allowing it to drip slowly down a slender wire. Where leaves, grasses, or plants are used in making stands it is always advisable to use the real objects dried and stained, but very excellent artificial leaves are for sale by all dealers in taxidermists' supplies, and these will answer most purposes. Always choose leaves that imitate well-known species found in the locality your mount represents, for conventional or ideal leaves are worse than nothing. Flowers should be avoided, for they are very unsatisfactory unless made by hand by an expert, and they add very little to the appearance of a group. Pond-lilies, however, are an exception, and some of the imitations of these found in millinery stores are very beautiful and add a great deal to any artificial water or pool. Strive to make your natural stands just as simple as possible while retaining the appearance of nature, and make careful studies and sketches, or photographs, of some spot in the woods or fields that you think will be suitable for the surroundings of your prepared specimen.

There is almost no limit to the time and trouble you can spend in making up a lifelike group of mammals, and if you become skilful in mounting large animals I advise you to have at least one good group of this sort. Do not try to get too much "action" in your specimens. Animals fighting

or devouring some other creature or in the act of springing or running never look natural, and it is better to select attitudes of repose or every-day life with just enough "action" to prevent the mounts from looking like dummies.

Most of our large museums now have splendid groups of mammals, and better ideas can be gained of methods employed and the arrangement of groups by examining some of the magnificent collections in our public museums than by reading any amount of description.

The failure or success of this sort of taxidermy depends almost entirely upon close observation, familiarity with nature, and knowledge of outdoor life; and a well-mounted group of mammals is proof positive that the boy who prepared it was a true nature-lover and a careful and ardent naturalist.

Chapter XXI

HUNTING THE SEA-COW

THE sea-cow, or manatee (Fig. 1), is one of the strangest of creatures. Shapeless and naked, with a small piglike head and almost invisible eyes, with a broad, fleshy tail and stout flippers, this odd amphibian appears a clumsy and ungainly beast indeed. In his native element, however, he is far from clumsy, and can swim and dive with the facility and quickness of a porpoise, while even on the muddy shores, where he loves to bask in the sunshine, he can travel quite rapidly. He is also a wary, cautious creature, taking alarm at the least sight or sound that in his mind presages danger, and exhibiting no little intelligence in avoiding his human enemies.

He is far from handsome, and, although it is said that the first manatees seen by Columbus were mistaken for mermaids, yet even the great navigator remarked upon their lack of beauty and stated that the mermaids were not "nearly as lovely as he had been led to believe."

The manatee is found in many portions of the American tropics, including Florida, but has been so extensively hunted that in most places he has become very rare and so shy that the few individuals remaining are almost impossible to find.

It was in the island of San Domingo that Columbus first saw his "mermaids," and in this lovely island the sea-cow is still abundant, and forms a regular article of diet for the natives. His flesh is excellent eating, and the natives assert that from his body either beef, pork, or fish can be obtained, according to the portion used. Although mainly hunted

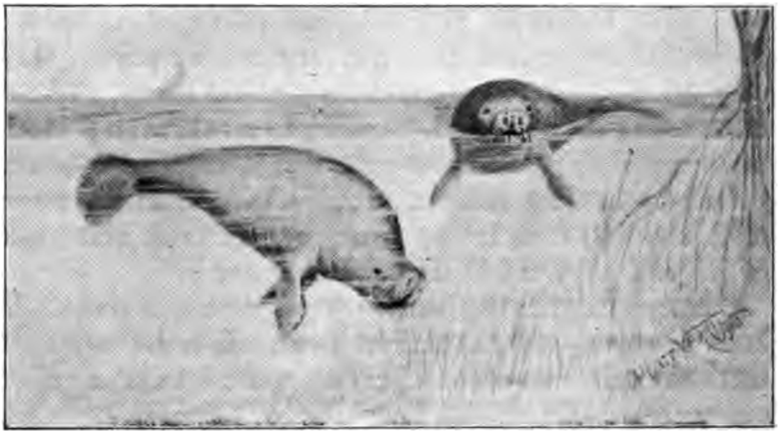

Fig. 1

for the flesh, yet the oil is also of value; the hide is tough and durable, while the bones are so hard and fine-grained as to form an excellent substitute for ivory. As the manatee feeds almost entirely upon aquatic plants and rarely comes to the surface except to breathe, or "blow," it is necessary to hunt him in boats with harpoons, although occasionally a stray sea-cow is captured in a fish-net by accident.

The feeding-grounds of the manatees are the shallow

bays, or lagoons, bordered with thick mangrove swamps, through which numerous winding creeks flow sluggishly.

Toward one of these broad lagoons my boatmen paddled quietly at daybreak one March morning, while an expert manatee-hunter crouched in the bow of my *cayuca*. These *cayucas*, or canoes, are odd craft and well worthy of notice. They are dug out from a single gigantic forest tree and are often forty feet in length. They are heavy, clumsy craft, but withal strong and seaworthy, and are so valuable that they are used until far beyond the point of safety. I have often seen a crowd of natives sailing in an old *cayuca* which had become so cracked and split that it required constant bailing by half the crew to keep it afloat, while the entire craft was held from falling apart only by yards and yards of telegraph wire wound around and around it.

Our manatee-hunting *cayuca* was a new and well-made boat, however, and was of light draught in order to enable us to penetrate the shallow lagoons and creeks in search of our quarry.

Paddling rapidly down the San Lorenzo River with its wooded banks, from which snowy-white egrets and heavy-winged ibis constantly flew at our approach, we presently reached the broad open expanse of San Lorenzo Bay. Skirting the shore close beneath the fringe of drooping mangrove trees the crew proceeded slowly and cautiously, while our hunter, standing upright in the bow, peered carefully about on every side. Silence was the order, and as we crept along the shore the only sounds that broke the silence of the dawn were the occasional loud "honk" of a startled ibis or the flapping of some wary heron's wings. We had proceeded

thus for a mile or more when the hunter, José, raised his hand and pointed to the water at one side. Following the gesture, I noted numerous bits of floating sea-grass—a sure sign that a sea-cow had been grazing on the bottom within a few moments. Instantly the paddlers ceased their motions, and the *cayuca* rested motionless upon the glassy waters of the bay.

Presently from beyond a mangrove-shaded point ahead there was a splash, followed by a loud bull-like bellow and a hissing as of escaping steam. With one accord the paddles struck the water and the *cayuca* shot forward, for the strange noises issued from a manatee as he came up to "blow." At racing speed we rounded the point, and I expected to see the creature in plain view and to see the upraised harpoon of our hunter flash forward, but in this I was disappointed. A slight ripple on the surface of the water was all that remained to mark the presence of the vanished sea-cow, and our crew again ceased paddling and rested on their oars. Presently they began very slowly and very gently to urge our craft over the quiet water, circling about, but ever drawing nearer and nearer to the farther shore.

Intently José scanned the surface, and again and again he indicated bits of floating sea-grass. Suddenly he raised his hand in a signal to the men; the paddles ceased, and the canoe glided silently forward; upon the surface a few yards ahead tiny bubbles were floating, and as we approached more rose upward from the dark water. To the skilled hunter these bubbles betrayed the presence of a manatee feeding beneath, and as the bow of our boat reached them the long-handled harpoon shot downward, cleaving the

water with scarce a splash, until half its length disappeared beneath the surface. As it sank the crew backed water furiously, while José, certain of his stroke, uncoiled and tossed overboard the strong, light line of native vines. Even before the canoe had checked its forward movement or the last of the line was clear the harpoon haft sprung forward as if endowed with life. For a few yards it rushed through the water, and then, the line coming taut, it bent like a reed; the line snapped from the water with a sounding twang, and our *cayuca* jerked forward a dozen feet. The first mad rush of a stricken sea-cow is fast and furious, but they seldom travel far or long, but seek some deep spot to sulk until compelled to come up to breathe, or at times even roll over and over, entangling the line, breaking the harpoon, and often gaining their freedom in the end.

The only danger is in the case of their seeking the devious creeks of the swamps where the low-hanging branches may sweep one from the boat or some submerged log may upset or wreck the canoe.

Our first sea-cow, however, had no intention of either sulking or rolling in the line, but kept rapidly forward, swimming now this way, now that, for several minutes. Then the line slackened for a moment, and the crew commenced hauling it in. A few feet only had been gathered up when suddenly, with a bellow that startled us half out of our wits, the manatee broke from the water within six inches of the boat, covering us with a shower of bloody spray, and with a loud hiss of indrawn air sank again out of sight. The battle was nearly over, however, and after a few more wild rushes our game gave up the fight and allowed

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himself to be hauled alongside, where he was quickly killed. He was then towed ashore, and proved a fine, large specimen, nearly eight feet in length. So far our morning had been interesting and more or less filled with excitement, but now came hard work to pay for it. The manatee was intended for one of our great museums, and to skin and prepare the heavy beast in a mosquito-ridden swamp was no easy or pleasant job. The day was far advanced when at last the work was finished, and, laden with skin, skeleton, and the best portions of the meat, we set forth in quest of more specimens. Our luck had turned, however, and although we heard several more manatees blowing in the swamps and found plenty of freshly chewed grass, yet with every effort José failed to harpoon a second sea-cow, although a huge saw-fish was added to the collection; and at last, tired and hungry, we paddled homeward up the river just as the sun sank beneath the western mountains and the noisy parrots flew in long lines toward their roosts.

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Part VI

MARINE INVERTEBRATES

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Chapter XXII

SHORE-ANIMALS

BOYS who are fortunate enough to live on or near the seashore will find that here is a vast treasure-house of strange and interesting life in a great variety of forms, and belonging to widely separated groups, and each and every one well worthy of a place in their collections. The immense number and variety of marine animals is appalling to the beginner, but their ways are so remarkable, their habits so strange, and their forms and structure so different from any land-animals that once we begin to collect and study them we become enthusiastic in the pursuit. Moreover, nearly all marine creatures are very easy to collect and prepare, and as few people are familiar with even the commonest species, the marine collection always proves attractive and full of interest.

Even if the young collector spends but a few months or weeks at the seashore during the summer he will find abundant material to keep him busy, for in the water, on the beaches, among the pebbles, under stones and seaweed, or burrowing in the mud are numbers of animals that will serve to fill up rapidly his museum shelves and cases.

So many branches of the animal kingdom are represented in marine life, and the number of species in each division is so great, that in a very short time the boy museum-builder may be able to divide his marine collections into several separate exhibits such as marine shells, crustaceans, annelids

Fig. 1

Fig. 2

Fig. 3

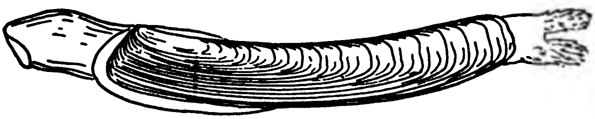

Fig. 4

(marine worms), echinoderms (starfish, etc.), sea-anemones, sponges, bryozoa, etc. The localities where each form of marine life occurs, the methods of collecting, the habits, their method of preservation and preparation vary so widely in every group that each must be taken separately and described in detail.

In the first place marine-invertebrate collecting may be roughly divided into:

1. Shore collecting between high and low tides.

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2. Collecting below low-water mark.
3. Collecting in deep water.
4. Collecting surface-animals.

Of all these the easiest to collect and the most commonly seen and best-known animals are those found between tides along the shores. Here we can collect readily and in comfort with few tools or appliances, and many days can be entirely devoted to the work without securing more than a small proportion of the creatures found in a very limited area.

Here, under the stones, in old cast-up seaweed, among the rocks and pebbles, in tiny tide-pools, and hidden in the sand or mud we will find a great variety of shells, snails, worms, crabs, shrimps, starfish, sea-anemones, etc., and before we start out we must be prepared to preserve almost any sort of creature included in the great multitude of marine invertebrates.

Notwithstanding the variety of forms we are likely to secure, the simplest and cheapest of outfits will answer. A few wide-mouthed bottles or jars, a basket or pail in which to carry them, a trowel or old kitchen knife, a pair of forceps, a dip-net and a short bar of iron and a good hammer are all that are required, but a small spade and a hoe are very useful, and will add to the number of specimens we obtain.

Always wear old clothes and stout shoes, and start on your collecting-trip just as the tide begins to fall, and if possible choose a day when the tide will be very low. Even before the tide begins to ebb you may obtain many good specimens among the flotsam and jetsam cast upon the beach; but, as a rule, these things that are washed up on the beach are dead,

faded, and worn, and are seldom really first-class specimens. In this trash, however, you may usually find the egg-cases of shells (Fig. 7), the odd, rubberlike eggs of skates (Fig. 9), and quite a number of small shells both of the univalve or snail-like species (Fig. 2), and bivalve or clamlike varieties (Fig. 1). Occasionally a well-preserved crab or shrimp will be found, or the dried and cast-off but perfect shell of a king-crab or horseshoe-fish (Fig. 3). Among the half-decayed seaweed and kelp you will also find many tiny, live crustaceans, or "sand-hoppers," with small scuttling crabs and other interesting creatures. The dead and dried things that are good enough to save should be placed in baskets or boxes, while the live things may be dropped into bottles of fresh sea-water or placed in boxes of damp seaweed.

As the tide falls you should look along the water's edge and search carefully for any living creature that may be running about at the edge of the waves. On a muddy or sandy shore many things may be found by digging in the wet sand or mud, for a large proportion of the shore-animals live buried out of sight. Many of these betray their presence by little piles of sand, holes, small tubes projecting above the surface, or by tiny spurts of water that spout up as you walk near.

Most of these creatures are very quick and retreat to the lowest parts of their burrows at the least sign of danger, and in order to secure them one must dig quickly and by one strong, deep stroke of the spade or trowel.

Among these timid beings that are hard to dig from their homes are razor-clams (Fig. 4), sea-cucumbers (Fig. 5),

[redacted]


Fig. 5


Fig. 6


Fig. 7


Fig. 8


Fig. 9

SOME SHORE SPECIMENS

various soft-bodied, whitish crustaceans, and a great many very beautifully-colored marine worms.

Many of the underground inhabitants are quite sluggish, and are easily dug out with a hoe or old rake, and in this class are the common long clams, long, white, snakelike worms known as nemerteans, and numerous small crabs

Fig. 10

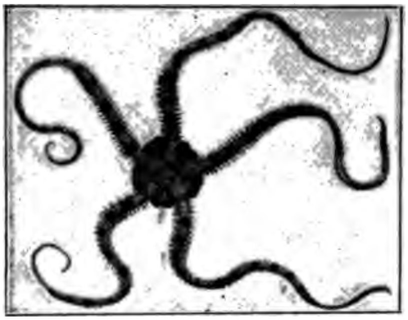

Fig. 11

Fig. 12

and bivalve shells. Still other creatures live beneath the surface and betray no sign of their presence, and the best way to get these is by digging up the moist sand and mud and sifting it through a wire sieve in the water. You will be surprised to find what a lot of queer and brightly colored

marine worms, shells, crustaceans, and other animals you will find by this method. If there are any rocky shores near by you will find a very rich collecting-ground under the stones, among the crevices of the rocks, and in the little pools of water left by the receding tide. In such places you will find starfish (Fig. 6) crawling over the rocks in shady spots or clinging to the cool underside of stones; hermit-crabs running about, carrying their shell houses on their backs (Fig. 8); rock-crabs and fiddlers scurrying out of sight under projecting rocks or masses of rockweed; and if you look sharp you will probably discover groups of delicately tinted sea-anemones waving their tentacles in the calm water of the pools (Fig. 10). Among old spiles and wharves, in eel-grass, in rockweed and kelp, and wherever the falling tide exposes masses of cool seaweeds you will find various interesting creatures. By paddling about in a boat and examining old spiles and timbers you will find a number of marine animals that never occur elsewhere, and among the soft, dark olive-colored eel-grass numerous curious creatures spend their lives. Among these are the fragile serpent starfish (Fig. 11), delicately fringed and graceful naked mollusks (Fig. 12), and a large number of handsome little shells of green, yellow, and pinkish tints.

Chapter XXIII

SHALLOW-WATER ANIMALS

AFTER you have become tired of collecting the many animals found between the tides you may turn your attention to those creatures that live just below low-water mark. To obtain these you must wade about knee-deep in the water and pry among the stones and seaweeds, dig into the sand and mud, rake up masses of rockweed and kelp, and, in fact, peek and pry into every crevice, crack, and hiding-place you find. Among the common things living below low-water mark are various extremely interesting crustaceans, such as lobsters, swimming-crabs (Fig. 1), spider-crabs (Fig. 2), mud-crabs, large hermits, a great variety of sea-shells, worms, starfish, serpent-stars, sea-anemones, and even the beautiful native coral that looks at first glance like a number of sea-anemones growing close together (Fig. 3).

Here on sandy bottoms you will find sand-dollars (Fig. 4) and sea-urchins (Fig. 5), which belong in the same group with the starfish, although they look so very different that you can scarcely believe it. If you rub off the sharp spines on the sea-urchin or the rough, almost invisible spines on the sand-dollar you will see the star-shaped pattern on the

Fig. 1

Fig. 2

Fig. 3

Fig. 4

top of the disk which corresponds to the rays or arms of the starfish (Fig. 6). Here also you may find numerous native sponges, such as the common scarlet sponge with its gorgeous coloring, the odd finger-sponges (Fig. 7), and soft, branched sponges that look at first like beautiful masses of branching coral. After collecting a good lot of specimens they should be assorted and placed in open dishes filled with fresh sea-water, and you may readily keep them alive for some time if you take care to change the water frequently and keep

the dishes in a cool and shady place. This is an excellent plan, as it will give you a splendid opportunity to make colored sketches of the brightly tinted species, and at the same time you can study the habits and ways of the many odd beings you have caught.

You will notice that the corals when undisturbed project out from the stony matter that we generally consider coral and wave their tentacles about exactly like the neighboring sea-anemones. You may watch the starfish crawl slowly about by the suckerlike feet along the under sides of his arms, while his cousins the hard-shelled sand-dollars and sea-urchins travel in exactly the same way. Hermit-crabs are always lively and friendly, and hurry and tumble about over and under everything, and are always interesting.

If you have collected some barnacles you will be greatly interested in watching them as they work their fringed organs out and in their little shells, breathing fresh water and gathering invisible particles of food at each stroke. These common barnacles are really very wonderful little fellows; and, although they bear but little resemblance to either crabs or shrimp, yet they are in reality first cousins, and in their younger days swim about freely in the water. As they grow older they settle down for a quiet life, and very soon inclose themselves with a conical shell of lime which they open and shut at will. Here they remain while their former legs alter to delicate fringed paddles that serve to draw their food within their shells and at the same time provide a constant circulation of clean water for breathing.

As soon as all your specimens have been placed in clear water you should go carefully over them and assort them

Fig. 5

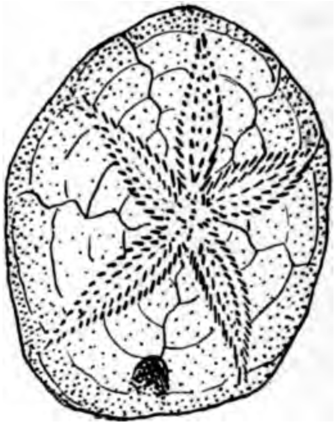

Fig. 6

Fig. 7

SHALLOW-WATER ANIMALS

in some sort of order. Pick out all the injured, dead, or sick specimens and drop them into bottles of alcohol or formaline. Masses of seaweed, bunches of mussels, and similar mixed things should be placed in a large dish with plenty of water; and small, delicate worms, crustaceans, etc., should be placed in separate dishes apart from the larger and livelier things, as otherwise they will soon be injured. Keep the starfish and sea-urchins separated from shells and mollusks, as these harmless-looking beings devour all kinds of shell-fish very quickly.

The bunches of seaweed, mussels, and other mixed lots will often contain many small and rare specimens of crustaceans, mollusks, etc., and should be carefully picked over and examined under water. Even when all the odd little creatures seem to have been picked out and discovered you will often find a number of others if the masses of material are left overnight in water.

As soon as the water begins to get foul numerous tiny creatures that are hidden in cracks and crannies or in tiny tubes or holes will come into sight seeking fresh water, and these are usually very interesting things.

As soon as you begin to look over your marine collections you will realize that a lens or magnifying-glass would aid you greatly, and every boy naturalist should be provided with a good pocket lens of some sort. If you are fortunate enough to own a compound microscope a new world will be opened for you when you commence to examine the tiny marine invertebrates. For examining living animals through a lens or microscope they should be placed in little watch-glasses filled with water. For picking up tiny crea-

tures for preservation or examination the best thing to use is a glass tube open at both ends. Keep one finger over the upper end, and place the lower end close to the specimen you want, when by removing the finger at the upper end a sudden current of water will run up into the tube and carry the object with it. Very tiny things may be picked up with a medicine-dropper.

If in your prying and hunting about you run across old rotten timbers or old broken spiles that are perforated with numerous holes, you should save one or two good pieces, and if these have not been exposed to the air too long you will find that a most interesting creature inhabits the holes in the wood. These are known as ship-worms, but in reality they are not worms at all, but odd bivalve shells related to the common clams (Fig. 8). The real name of this queer creature is teredo, and it causes an enormous amount of damage to spiles, wharves, boats, and, in fact, any woodwork below high-water mark. The holes are very small at the surface of the wood where they are begun by the very young animals, but as they increase in age and size they enlarge their holes as they bore here and there, until holes of full-grown teredos are a quarter or three-eighths of an inch in diameter (Fig. 9). The holes run through the wood in every direction, until it is a mere shell honeycombed with the holes, which never touch or cross, but pass and twist by one another with a mere film of wood between. Each of the holes is lined throughout its length by a smooth wall or tube of lime, and within these the teredos live; they do not eat the wood, but obtain their food from the sea-water which runs through the tubes. The young

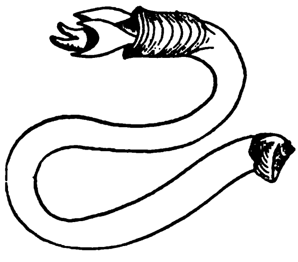

Fig. 8

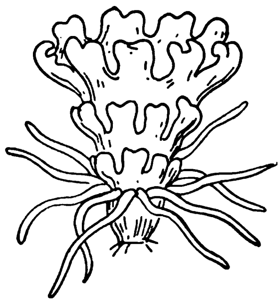

Fig. 10

Fig. 9

teredos have a regular bivalve shell which covers them, but as soon as they commence to burrow in wood they grow in length, while the shell remains small, until when fully grown they appear long and wormlike, with the shell so small and altered in form that you would scarcely recognize it as a shell at all. Among your masses of weeds and eel-grass you will often find tiny groups of branched animals that look like minute corals or hard seaweed. These are bryozoa, and are true animals, and when examined through the lens or microscope will be found very beautiful.

Still another form of animal that at first appears like plants is the hydroid. There are a great many species of these, and some of them are especially interesting, as they produce buds which break off and turn into jellyfish. The jellyfish swim off and their eggs produce more hydroids, which in turn send forth jellyfish in a most wonderful way. All the jellyfish are not produced in this way, however, for some species lay eggs that hatch directly into other jellyfish, while still others have young that look like sea-anemones and attach themselves to the bottom. These anemone-like young grow upward in a series of joints, and every little while one of the joints breaks off and swims away as a new jellyfish (Fig. 10).

Chapter XXIV

SURFACE-ANIMALS

THE creatures I have described as living on or near low-water mark on the shores and beaches are far the easiest to collect of all marine animals, and, as a rule, are the kinds most frequently seen in collections. They form but a very small proportion of marine life, however, and vast numbers of small but interesting things live at the surface of the sea and must be collected by nets. Ordinary nets are too coarse for this purpose, and the net to be used for collecting surface-animals should be made of cheese-cloth or fine muslin with a rounded bottom free from corners, and the hoop should be of brass or heavily galvanized wire. Two of these nets should be on hand; one fastened to a handle, and the other attached to a rope as shown in Fig. 1, so that it may be dragged along behind a sail-boat, launch, or rowboat. The number of creatures living on the surface is very great, although at first you would never suspect their presence, as they are mostly either so transparent or so nearly like their surroundings in color as to be absolutely invisible from above but easily seen in an aquarium or bottle. Many of these transparent creatures become perfectly opaque in alcohol or

formaline, and make very nice specimens. Vast multitudes of microscopic animals teem in the water, and these, with many of the larger kinds, produce the phosphorescence that is seen on warm summer nights when sailing or rowing, for a great many forms of marine life give forth a faint glow, and some kinds produce very brilliant lights.

By far the greatest number of surface-animals may be found in the evening in warm weather, when the sea is calm, for in cold or rough weather they go below and are hard to collect.

When you wish to collect surface-animals you should throw your drag-net from the stern of your boat and row, sail, or run your boat about in circles for some time, and whenever you see a floating bit of weed or trash gather it up with your dip-net and place it in a bucket of water. After towing the net for some time haul it in and turn it inside out in a pail of fresh sea-water. There may be a number of fairly large things in the haul, such as jellyfish, small fish, or swimming-crabs; but more probably you will see apparently few living objects. Possibly you will note a pair of dark or black spots moving about side by side without apparent reason. Place the water in a glass dish on a dark surface, with a strong light, and you will be surprised to find that the two spots are the eyes of a graceful eel-like fish as transparent as glass. This is the young of the conger-eel, and, while not common, they are by no means unusual. In addition to this odd animal you will probably find a lot of other creatures, equally transparent, swimming about; some of these will soon group themselves in masses near the light, while others will sink to the bottom or gather round the edges of the dish. The

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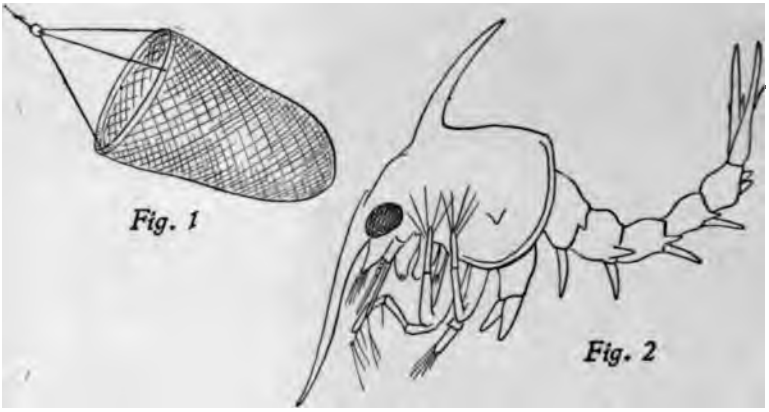

Fig. 1

Fig. 2

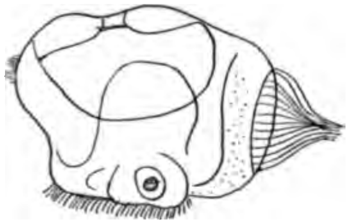

Fig. 3

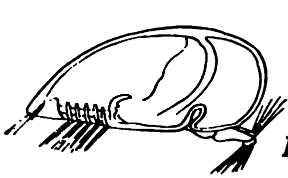

Fig. 4

Fig. 5

SURFACE-NET AND SURFACE-ANIMALS

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most numerous and active creatures will probably prove to be small crustaceans or shrimplike animals. Some of these are very beautiful, and if examined at night will give out a multicolored phosphorescent glow.

Among these you will find a number of odd creatures that appear like Fig. 2, and, although you would never guess it, these are really baby crabs. Young oysters (Fig. 3) and young barnacles (Fig. 4) will almost always be found in surface hauls, and these are most interesting creatures to observe and study.

Young sea-urchins and baby starfishes (Fig. 5) also occur in large numbers at the suface, and you may spend hours watching these minute but wonderfully interesting atoms of life.

Although the majority of the surface-animals are too small or too fragile to preserve for exhibition in your museum, you will undoubtedly obtain many large and valuable things. Commonest among these are the jellyfish already mentioned. Most of these are very difficult to preserve satisfactorily, but some of them make very good and attractive specimens, and the only way to determine which may be preserved and which may not is to try them all and throw away those that go to pieces or contract too much.

If you collect in the south or along the outlying capes of the Atlantic coast you may be fortunate enough to secure a specimen of the Portuguese man-o'-war. These are brilliantly colored, opalescent creatures consisting of a transparent, bladderlike float of soft pinks, blues, and purples, with long, streaming tentacles of blue and pink hanging down in the water. If such an animal is captured you must be

very careful indeed not to touch the tentacles with your bare hands, for they sting and poison terribly, and serious results may follow; even the bits of broken or torn tentacles that adhere to the net will sting and will kill any small animal that comes in contact with them. Never place live jelly-fishes in a pail or other receptacle with other creatures, for nearly all of these beautiful animals can kill small fish and

Fig. 6

Fig. 7

similar creatures. Notwithstanding this power there are certain species of crustaceans and fish that habitually live right among the death-dealing tentacles of the man-o'-war (Fig. 6).

Other good-sized surface-animals frequently captured are the small squids or cuttlefishes (Fig. 7). These are very

abundant at certain seasons of the year and are caught by fishermen for bait. They are very easy to preserve, but in order to exhibit them to the best advantage they should be fastened to a thin board or strip of celluloid as soon as killed and then kept in alcohol or formaline until they become firm and hard. They may then be placed in a jar, mount and all.

Chapter XXV

DEEP-WATER ANIMALS

INTERESTING as you will find shore and surface collecting, if you start dredging or trawling for bottom specimens you will find it the most attractive and fascinating work of all. Here you are working on ground never seen by man, and with every haul of dredge or trawl you are likely to find some creature unknown to science, and are always sure of obtaining a great number of animals quite new to you and your friends and very valuable for your museum collection. The instruments used in bottom collecting are more numerous and bulky than those already described, but they are all easily made and are quite inexpensive. The principal things, aside from the jars, forceps, pails, sieve, etc., that you used in shore and surface work, are a rectangular dredge (Fig. 1), a beam-trawl (Fig. 2), and tangles (Fig. 3).

The frame of the dredge can be made by any blacksmith or by a boy at all familiar with iron work, and for your use it can be made of light iron not over one-quarter of an inch thick. The scrapers (AA) should not flare too much, for if they do it will be likely to catch on rocks and other objects, besides digging up a lot of mud and useless dirt. The net (BB) is fastened to the frame by tarred rope or copper wire,

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and outside of the net an open bag of canvas is placed to protect the net from tearing (X). An old fish-net may be made over for the dredge, but if possible it is better to get a new net. These dredge-nets are not costly and may be bought of almost any dealer in nets and fishing-tackle. It is a good plan to have the lower end of the net left open and merely tied together with rope, as this saves a lot of trouble in turning the net inside out at each haul. The rope should

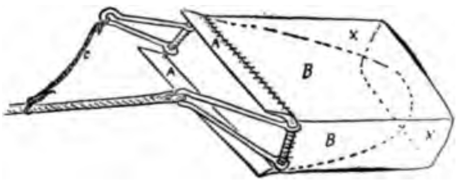

Fig. 1

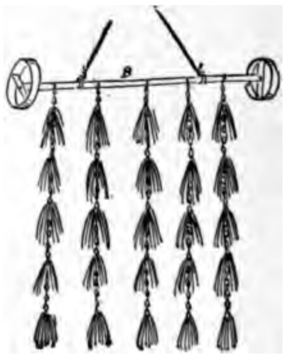

Fig. 3

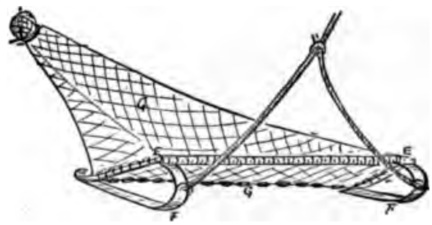

Fig. 2

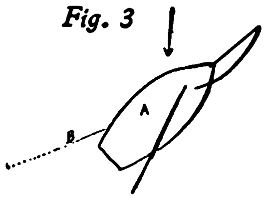

Fig. 4

be fastened to the dredge as shown in the figure, as by this arrangement the small line (C) breaks if the dredge catches on a rock or similar obstruction, and the dredge will then swing end on and pull off the object on which it has fouled.

A short distance from the dredge a weight should be fastened to the main rope to keep the taut stretch of the latter from lifting the mouth of the dredge from the bottom.

The trawl (Fig. 2) consists of an iron frame (F), an iron or wooden beam (E), and a net with one edge weighted with lead (G). The frame may be made of flat iron or may be constructed of iron pipe (the latter is preferable for the beam). The tangles (Fig. 3) can be made by any boy, and consists merely of bunches of twine or raveled rope fastened to chains so it may be dragged over the bottom by a rope attached to the beam (B). The beam should also have iron hoops or wooden wheels at each end as shown in the cut to prevent the ends from catching under projecting rocks and to keep the beam itself from dragging.

The dredge should be used on muddy or sandy bottoms, the trawl on mud, sand, or mixed bottoms, and the tangles anywhere, but preferably on rough or rocky bottoms where a trawl or dredge would be caught or torn.

To dredge, trawl, or tangle from a rowboat or launch is very easy, as it is only necessary to throw over the appliance selected and then row or run the boat slowly ahead until you consider it time to see what you have caught. In dredging from a sail-boat care should be used, and the work should not be attempted unless two people thoroughly familiar with sailing boats are working together. If the current is strong the dredge or trawl may be fastened to the bows of the boat and the latter allowed to drift slowly, exactly as though she were dragging her anchor; or, if the current is not strong enough to move the dredge in this way, a bridle rope may be brought from the stern of the boat so

she will swing broadside onto the current and thus have more force. If there is no strong tide or current to work for you it is best to tow the trawl or dredge behind the boat as slowly as the wind will permit, and for this purpose the sails should be reefed down as closely as you can even when

Fig. 5

working with light winds; steerageway is all that is required, for any considerable speed will cause the dredge or trawl to jump from spot to spot and miss many of the best things.

The most favorable position for dredging with a sailboat is shown in Fig. 4, in which the arrow shows the direction of the wind (A), the boat (B), and the dredge rope. In this position the boat may be luffed up slightly to keep her moving slowly, while if the dredge sticks or hangs back the boat may be quickly brought into the wind.

If you cannot secure dredges, trawls, or a boat for your own use you can obtain a large variety of bottom-animals

by going out on the oyster-dredging steamers, and among the oysters brought up you will find large numbers of shells, crabs, sea-anemones, crustaceans, and other creatures, while the oyster's worst enemy, the starfishes, are everywhere. A very interesting exhibit may be made of oysters alone in their various forms and ages. A drawing of the young free-swimming oyster larva should be shown with a stone or other object covered with the "oyster set" (Fig. 5). Half-grown and fully-grown oysters in their natural position of growth will show the appearance of mature oysters, and as a further illustration of their life history you should exhibit some shells bored by sponges and "drills" (Fig. 6).

Fig. 6

Many splendid specimens of species never caught in dredges, trawls, or tangles may be obtained by setting traps or pots. The common lobster pots, made of laths nailed over a wooden frame (Fig. 7), are splendid for this purpose.

These pots are weighted with bricks or stones inside, and are baited with dead fish or old meat and lowered to the bottom in deep water. The rope should be considerably longer than the depth of the water, and at the end there should be a wooden or cork float or buoy. Just below this, say at a distance of ten feet, there should be another buoy or float. These serve to keep the line from sinking or "running under"

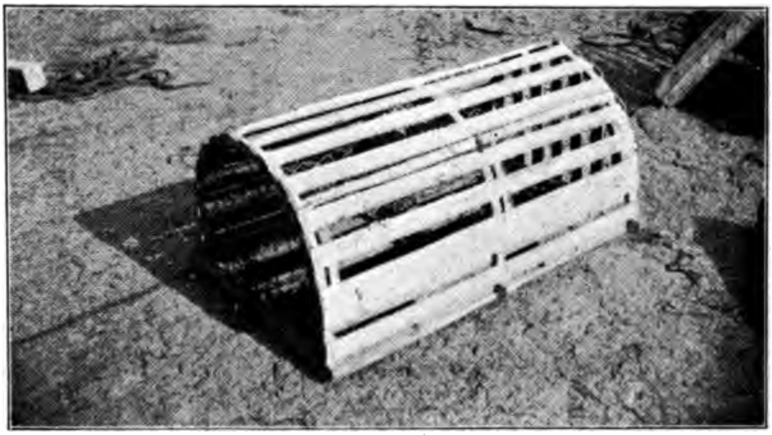

Fig. 7

with the tides, and act as marks to show where the pots are set. The creatures that are attracted by the bait crawl into the pot through a netting funnel, but cannot find their way out. Usually two funnels are provided, one at the outer end, and another in the middle of the pot to make sure that the captured animals cannot escape. One side of the pot is provided with a section that is hinged and tied shut, or is locked in position by a button or latch. The pot

should be left a day or two before pulling it up, and you will almost invariably find it filled with large spider-crabs, various large shells such as "winkles," rock-crabs, large hermit-crabs, and oftentimes lobsters, and frequently large fish such as sea-bass, "tautog," or blackfish.

If you do not care to make and set your own pots you can go out with some of the lobstermen, and they will be only too glad to give you all the specimens they get, which are merely pests to them and eat up their bait. For a few cents, or even by merely requesting them, these lobstermen will usually be glad to bring in all the unusual animals they find in their pots, and among them you may often get very rare things for your museum.

Chapter XXVI

PRESERVATION OF MARINE ANIMALS

THE preservation of any marine animal is best accomplished by placing it in alcohol or formaline, and for a great many things this will be all that is required. Certain species, however, require special treatment, and to describe better and more simply the methods to be employed in the preparation of various groups we may classify them and describe the special requirements of each.

Crustaceans include all the shrimps, crabs, lobsters, sow-bugs, sand-hoppers, and related creatures with hard or semi-hard skins.

Practically all crustaceans may be soaked in alcohol or formaline and then spread out in a natural attitude on a board and carefully dried. If their colors in life are bright or varied the dried specimens may be touched up with artists' colors and a fine brush.

Mollusks include shells, snails, naked mollusks, clams, oysters, squids, etc. Any of the snails or shells may be prepared by removing the animals, after soaking in alcohol, and then drying the shells, but it is a good plan to preserve some of each kind with the animal itself expanded. If the living shell is placed directly in alcohol the animal will contract

out of sight within his shell, and to prevent this a preparation must be made that will cause the creature to expand and at the same time become stupefied. By making a strong solution of chloride or sulphate of magnesia and adding this a little at a time to the water in which the animals are kept alive they will expand to their full extent and will soon show signs of stupefaction by refusing to contract when touched. When this occurs you can drop the specimens into the preserving solution of alcohol or formaline without fear of their contracting. Naked mollusks may be treated in the same way, and in all cases formaline is far superior to alcohol for preserving marine animals, as it does not fade the colors as much and does not harden and contract them to so great an extent.

Worms or *Annelids* include a very great number of genera and species, and the majority need only be dropped into formaline. Some species, however, break into a lot of pieces when treated in this way, and the only way to tell just how best to preserve a certain kind is to experiment. Oftentimes the more delicate species may be beautifully preserved by killing them gradually by adding fresh-water to the salt until the worms are dead or unconscious, when they may be put in formaline without fear of breaking up. Many species may also be treated with the magnesium solution as above described.

Radiates include the starfishes, sea-urchins, sand-dollars, etc. Sand-dollars and sea-urchins may be simply soaked in alcohol or formaline and dried, but starfishes are usually badly shrunken and distorted if prepared in this manner. If the freshly caught living starfish are placed in a dish of

fresh-water (not salt) for a few hours they will become fully expanded and plump, and will finally die in this condition. They may then be soaked in broad, flat dishes of formaline, and after a day or two stretched out on boards and pinned in a symmetrical position. They should then be partly dried in a shady, cool spot and finally placed in a moderately hot oven until they are dry and hard. The addition of the magnesium-salt solutions to water in which starfish are being kept will also cause them to expand. Serpent-starfish will usually break up if placed directly in alcohol or formaline, and should be killed by slowly adding fresh-water to the dish in which they are kept alive. Sometimes these radiates may be killed with gasolene or benzine without causing them to contract or break.

Sponges simply require soaking in alcohol or formaline and then drying, while *corals* should be soaked in fresh-water and potash until the meaty or animal matter has dissolved, when they should be thoroughly washed under a stream of water and dried and bleached in the sun. If it is desired to preserve any corals with the animals in place they should be treated with the magnesium salts to make them expand, and should then be preserved in formaline. Most people have never seen a coral with the animal in place, and consider the dried skeletons that we call "coral" as the natural condition of the specimen. As a matter of fact, the living corals are very handsomely colored, and each star, rose, or irregularly shaped opening in the skeleton bears in life a graceful sea-anemone-like animal, the whole appearing like a mass of bright-colored flowers (Fig. 1). If a coral with the animal expanded (Fig. 2) is exhibited

in formaline beside the same species cleaned and dried (Fig. 2 *a*), it will invariably create a great deal of interest. The illustration shows the common rose coral of Bermuda and our Southern coast prepared in this way. Sea-anemones, if killed in formaline without preparation, will

Fig. 1

Fig. 2

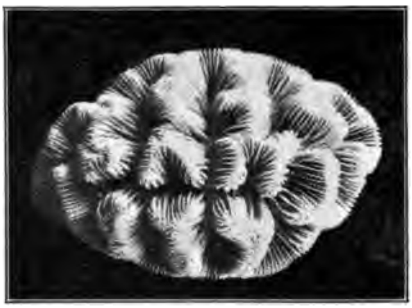

Fig. 2 a

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look merely like shapeless dull-colored masses of flesh, but if expanded and killed by the use of magnesium salts they will be as graceful and beautiful as when living.

Jellyfish may be preserved in formaline, and some kinds will preserve without the least trouble, while others go to pieces or shrivel up. As before mentioned, experimenting is the only way to determine how best to preserve these animals, but, as a rule, magnesium or fresh-water treatment does not greatly facilitate their final preservation.

Larval forms of any marine animals, as well as the various smaller forms of life, should be preserved in bottles of formaline, and for exhibition only one or two of a kind should be in a bottle.

Labels for marine things should bear the customary details of date, locality, name of specimen, number in catalogue, and in addition should state whether found on the shore, at the surface or bottom, and if taken at the bottom the depth in fathoms should be noted.

Algæ, or seaweeds, make attractive and interesting exhibits, and, while they properly belong in the botanical collection, a few words regarding their preparation may be of value in this department, as they are usually found in the greatest numbers and most perfect condition when collecting marine animals. Any algæ for preservation should be placed in clean sea-water and the various species or varieties separated. Then place the specimen selected for preservation in a dish of fresh (not salt) water and slip a sheet of thin Bristol-board or stiff paper beneath it. Arrange the weed in an attractive position over the card or paper, allowing just enough water to cover the latter, so that the weed

may be readily moved about but does not wiggle and float free. When fully arranged to your taste lift the paper and weed out of the dish carefully and set the whole on clean blotting-paper to dry. Another sheet of blotting-paper may be placed over it and the whole pressed together, if desired; flatter and smoother specimens are obtained in this way.

One great value of the marine-invertebrate collection is that you may almost always exchange marine specimens with boy collectors that live in the interior for excellent specimens of other groups found in their localities.

Birds, birds' nests, insects, flowers, and minerals can be obtained almost anywhere, and do not differ greatly in one section of the country from similar species in another district; but marine animals can only be obtained on the sea-coasts, and must be purchased or exchanged if boys in the interior—or grown-up collectors, for that matter—are to have examples of these wonderful forms of life in their collections.

Chapter XXVII

CORAL ISLANDS AND HOW THEY ARE FORMED

ALTHOUGH we frequently hear the Bermudas and other West-Indian islands spoken of as coral islands, they are not really coral islands at all. In fact, there are no true coral islands in the Atlantic, and these so-called coral islands are very different indeed from those of the Pacific and Indian oceans.

True coral islands, or atolls, are formed by corals building upward on a submerged reef or peak until the growth reaches the surface of the sea, or near it, so that broken pieces of coral, drift-sand, rubbish, seaweed, bits of driftwood, and other odds and ends accumulate and in time build an exposed islet. At other times a submarine mountain or volcanic peak becomes incrusted with corals and other marine growth, and then, by some volcanic disturbance, the entire coral reef is pushed up above the surface of the sea.

Many of the Pacific reefs are circular in form, or are semicircular, with one or more breaks or openings, and such reefs or islets are known as atolls. Sometimes coral reefs or islands are very large, and the largest of all, the Great Barrier Reef in Australia, extends for over a thousand miles.

The coral islands of the Atlantic are formed by wave-

broken shells and bits of coral which have become detached from submerged reefs and washed up on the beaches of volcanic islands. Through countless ages this sand, composed of shells and other objects containing a large proportion of lime, has been exposed to rain and wind until it has drifted into hills and dunes, and the water has percolated through it and dissolved the lime, which has again solidified until what were once mere sand hills are now solid stone.

This rock is known as Æolian limestone, and after exposure to the air it becomes exceedingly hard and durable, but when freshly broken or cut it is very soft and may be chiseled and sawed into blocks for building purposes.

In Bermuda the entire process of the transition from wind-drifted beach-sand to the hardest rocks may be witnessed, and in many places it is very hard to tell just where the sand ceases and real rock begins. In this sand-formed rock there are often numerous fossil shells and bits of coral, and for this reason a person unfamiliar with the formation might think the material true coral. In several places in the Bermudas we may also find atolls that look very much like true coral atolls, but an examination will show that they are really formed of innumerable worm-tubes thickly incrusted with coralline, bryozoa, seaweeds, small corals, and other marine growths and thus have the external appearance of being wholly built of coral.

The circular form of these Bermuda atolls is caused by the breaking waves cutting and washing away the original rock; and, as the animal life is renewed as rapidly as destroyed, the rock gradually disappears and only the animal-built substance remains. As all these creatures build out-

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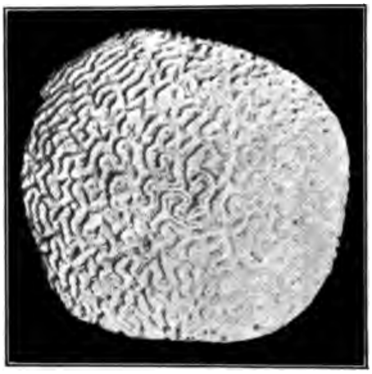
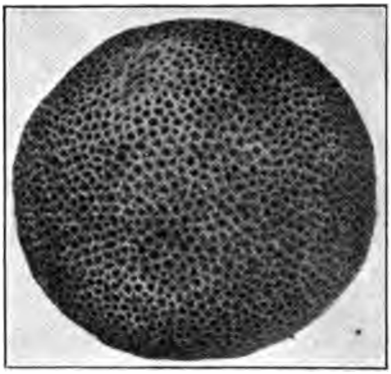
ward in every direction, a circular or semicircular wall results, which in the end often becomes filled up in the center, forming a solid islet. These "serpuline atolls," as they are properly called, never become large, and are seldom more than a few yards in diameter.



BRAIN-CORAL



STAR CORAL

ATOLLS AT BERMUDA

Many of the larger West-Indian islands are partly composed of coral reefs which have been raised far above the present sea-level by volcanic action.

Such elevated reefs are often found hundreds of feet above the sea, and in some places alternating layers of coral rock and lava are seen, thus proving that the islands have been raised and submerged several times in the past.

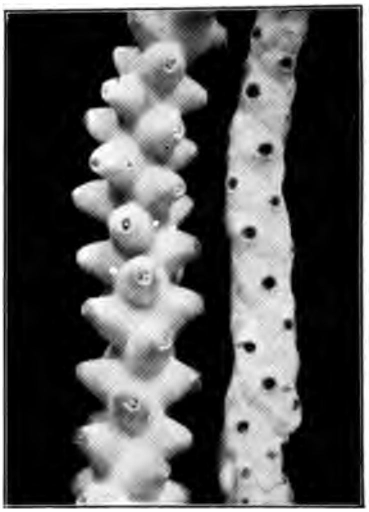
In all these cases, however, the amount of coral rock, as compared with the volcanic rock, is very small, and the occurrence of these isolated reefs far above the water does not entitle the island to be considered a coral island.

Very few people have any idea what living corals look like, for they have seen only the dried and bleached skeletons which we commonly call coral. Living corals are never white, but are brightly and beautifully colored with vivid shades of emerald-green, pink, brown, yellow, orange, lavender, purple, and rose.

A mass of living corals, when seen through the wonderfully clear waters of a tropical sea, is a very beautiful and gorgeous sight. Each coral is of a distinct shade, and in place of the stony skeletons the coral masses are covered with multitudes of coral animals, each fringed with delicate waving tentacles like those of sea-anemones.

There are a very great many kinds of corals; some are rounded and massive, and are known as brain-corals; others are broad, flat, and spreading and look like huge mushrooms or fungi; others are branched like trees or shrubs; while still others are made up of thin, delicate ridges which cause them to look so much like flowers that they are commonly called rose corals. Many of the species are very beautifully formed when examined close to or under a lens, and the numerous tiny openings, which in life supported the animals, appear like many-rayed stars or rosettes.

When alive each tiny sea-anemone-like animal occupies an opening in the skeleton, or stony part, and their bases spread over the intervening portions and join together to



BRANCHED CORALS DRY AND CLEANED

BRANCHED CORALS WITH LIVING POLYPS

form a fleshy covering to the entire coral. This flesh or skin contains the color, and after this is removed the white skeleton, or well-known coral, is visible. All these corals described are known as stony corals, but a great many other corals belong to a group known as the horny corals, or gorgonias. The well-known sea-fans and the sea-rods, as well as the beautiful red coral or precious coral used for jewelry, belong to this class. In life these horny corals are also covered with polyps, or animals with tentacles, like

sea-anemones, and when living they are often quite brightly colored. Unlike the stony corals, the gorgonias have a horny or somewhat flexible stem which in some species has a hard, smooth central portion. It is this pith, or core, that furnishes the precious red coral of the Mediterranean.

Corals are usually associated with southern seas, but in reality many species occur outside of the tropics. Some species are found as far north as Newfoundland and Greenland, but these are all deep-sea species, and do not belong to the reef-building groups. One small species is quite common along the coast of New England and is even found in tide pools above low-water mark, but Bermuda marks the northern limit of reef-building species in the Atlantic.

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Part VII

ROCKS, MINERALS, AND FOSSILS

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Chapter XXVIII

MINERALS AND ROCKS

SPECIMENS included in this collection have numerous advantages over all other groups, as they are very easy to collect, they can be roughly or carelessly handled in most cases, and they require but little preparation for exhibition. Moreover, they do not spoil or deteriorate by keeping, and can be arranged and prepared at leisure.

The vast importance of these specimens is seldom appreciated by either the young collectors or the public, for comparatively few kinds are beautiful, striking, or interesting in appearance. Nevertheless, a knowledge of rocks and minerals is very valuable, and may often prove very profitable to the young mineralogist. Many mines and rich deposits have been discovered by boys with a knowledge of rocks and minerals; a farmer's son with an interest in mineralogy first discovered the wonderful tourmalines and beryls of Maine, which have since brought fortunes to several men and are among the most beautiful of gems.

Only by rocks and minerals can we read the history of our planet, and a study of the various strata and the formation

of rocks, mountains, and plains will reveal a fascinating story of prehistoric days, when the earth was crude and new, when huge volcanoes in violent eruption reared their smoking summits where we now find placid lakes, while mighty inland seas spread, storm-swept and desolate, over vast areas that are now sunny prairies, golden with their harvests of waving corn and grain.

Minerals and rocks are found everywhere, for even on bare plains and prairies earths and sand are made up of decomposed or pulverized rocks, and an occasional meteorite may be found. These fragments of other worlds are of immense interest and value, and furnish some slight clues to the mineralogy of the distant stars.

Books are very necessary if you intend collecting and studying rocks and minerals deeply, but there are so many excellent books published on the subject that you will have no difficulty in obtaining what you want from some public library or from your school or college. For ordinary collecting you only require the names of your specimens, and the majority of these you can readily identify by color, hardness, or crystalline form, or by comparison with specimens in any large museum. Most mineralogists are very glad to help identify specimens sent them, and whenever you find an unknown or unusual specimen that you cannot name you should send a piece of it to some expert or professional mineralogist and allow him to retain the piece in return for his trouble. Many of these things will be common and of no interest or value, but some of them may be rare or interesting, and such specimens will usually repay any interested person for the trouble and time necessary to

identify the common things. In the majority of cases, however, you will find no difficulty in determining the names yourself, and if you do have trouble at first you will have all the more satisfaction when you finally succeed.

The only tools and implements required for the actual collection and preparation of your minerals and rocks are a few good cold-chisels, a geological hammer, and a canvas or leather bag or sack for carrying the specimens.

Mountainous or hilly districts are the most suitable localities for collecting; and outcropping ledges in hillside pastures, exposed cliffs, debris slopes, and wayside boulders

Fig. 1

are all fine places for minerals. Old stone walls often contain many fine and rare specimens, and stony river-beds and railroad cuts afford very rich collecting-grounds.

Whenever you find a pebble, rock, or boulder that looks odd or interesting break it open with your hammer and preserve a good piece of it. Sometimes a dull, rounded, uninviting rock if broken open will prove to be hollow and filled with magnificent crystals of quartz, tourmaline, or amethyst (Fig. 1). These are known as geodes, and are very common in some localities. At other times you will find veins of minerals running through other rock, and these are always promising collecting-grounds for rare things. By breaking the rock and chipping away you may secure specimens of the vein, and by following it up you may find that it contains rare or beautiful crystals or rich deposits of metal such as iron, lead, tin, copper, silver, or even gold. Iron pyrites is a very common mineral, and is very handsome. It may be either silvery or golden in color, and often looks so much like gold that it is mistaken for it; for this reason it is commonly known as "fools' gold."

Igneous rocks, such as granite and trap, frequently contain very rare minerals and beautiful crystals, and if the granite contains veins and cavities where feldspar and other minerals have decomposed you are very likely to find handsome crystals of red or green tourmaline, amethyst, beryl, or other semi-precious stones.

In mining districts you can obtain a great many interesting things, for, as a rule, metal ores usually contain various substances, and in their several combinations and proportions they seem like very distinct minerals. Moreover, the

chemical salts of metals in their ores often produce very beautiful coloring in other minerals, especially where found in crystalline forms, and if you get acquainted with miners or quarrymen they will be glad to save any odd or striking specimens they come across in their work.

A single cliff or ledge will often afford several days' work to the mineral-collector, for in various portions of the same outcrop very different minerals may be found, and only by going over it very thoroughly and chipping off here and there can you be sure that you have not missed the most valuable specimens.

Large or bulky specimens are not at all necessary, and they soon fill up the sack or bag and are heavy to carry home, but very small specimens or fragments are of little value. The best way is usually to break the piece of rock into a number of pieces and select two or three of medium size that show the color, texture, or formation to the best advantage.

Where masses of crystals occur you should try to get them as large and perfect as possible, and instead of breaking them off with a hammer you should cut away around them with the chisels. Sometimes it is necessary to cover or wrap crystalline masses with old rags or burlap to prevent the jar of the hammering from breaking or cracking them, but a lot of trouble and work is well repaid when you at last succeed in getting out a perfect specimen of some handsome crystals.

You should never throw small crystals or masses of crystals in with ordinary specimens, but should wrap them in cloth and place them in your pockets or in a separate bag for transporting them.

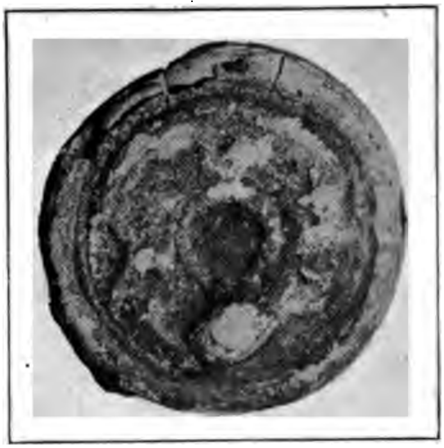

Fig. 2

Some kinds of minerals occur quite commonly in soft earth, sand, clay, or mud, and are seldom seen except when exposed by heavy rains or by landslides or in the banks of streams. These forms are usually crystals, and may have been left by decomposing rocks in which they were once inclosed, or may have been carried into the earth or sand by freshets years ago. Topaz crystals often occur in this way, and oddly shaped crystalline formations of sandstone are also found in similar situations. In clay-beds you will often find strange-looking masses of stonelike material which are readily broken open and disclose layers or concentric rings (Fig. 2). These are known as concretions, and are very common in some places. They are interesting things, however, and a collection of the various forms they assume is very attractive.

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It is almost impossible to enumerate all the odd and peculiar as well as interesting or valuable specimens you may find, or to describe all the localities where you will be likely to find them, and the only way to succeed is to look everywhere, and never pass by any rock or mineral without examining it if it looks the least bit unusual or unlike its surroundings.

Sometimes you will find a vein or ledge that looks promising, but which you cannot chip or break away to any extent. In such cases you had better get some miner or quarryman to put in a blast for you. If you are in a district where ores occur he will probably be glad to do this on the chance of striking a good vein of ore, but even if you have to pay the man for his time it will probably be well worth the expense if you disclose any good specimens.

If you collect in a limestone district you may discover the entrance to cavern or cave, and if this is of any considerable size you will find the roof hung with beautiful white or delicately tinted stalactites, and the floor irregular with hardened transparent limestone or with numerous pointed projections known as stalagmites (Fig. 3). These caves are sometimes very extensive, and turn and twist for miles underground. The water from the rains percolates through the earth and stone above and carries with it small quantities of lime in solution. Where this gathers on the roof of the cave the lime crystallizes and hardens and forms a tiny excrescence. In time these increase in size, and as the water naturally follows the irregularities and drips from the points, a pendant conical stalactite is formed exactly as icicles are formed by slowly freezing water. Wherever the

water carrying lime drips from the stalactites to the floor below it builds up another cone of limestone and forms a stalagmite. In time the stalactite and stalagmite will join and form a column, and in some caves these columns are very massive. At other times the lime-impregnated water runs slowly over masses of rocks or piles of sand and coats them with a glistening, stony shell, which is often very

Fig. 3

beautifully formed and looks like intricate carvings or lace work. It is very interesting to explore these stalactite caves; but, as many of them are partly filled with water to a great depth, it is very dangerous to attempt to enter them without a torch or light of some sort.

Chapter XXIX

PREPARING THE MINERALS

WHEN you are ready to prepare your mineral specimens for exhibition you should assort them carefully and select the best specimens and mark a number on each with indelible ink or paint and number any duplicates of the same kind to correspond. All outside dirt and foreign matter, such as moss, lichens, etc., should be brushed and cleaned off, the specimen labeled, and either placed in a cardboard tray or attached to a wooden or cardboard mount or stand; and crystals should be arranged to show the perfect faces to the best advantage (Fig. 3).

Every specimen should be selected so as to show the peculiarities of its formation or cleavage. Thus, trap has a peculiar and regular way of breaking, and a piece showing this should be exhibited. Some rocks run in regular layers or veins, and pieces large enough to illustrate this must be selected. Flexible sandstone looks very much like any other sandstone if shown in small pieces, but if you mount a long, thin piece with the ends supported on blocks of wood its own weight will bend down the middle and thus disclose its flexible character (Fig. 1). As far as possible you should arrange the various classes of rocks and minerals in groups,

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or separate collections, slightly apart from one another. Thus the granites, gneiss, etc., may be in one group; the various volcanic rocks, such as trap, basalt, lava, and pumice, in another group; sandstones and conglomerates, slates, and schists in another; quartz, amethyst, and agate in another; native copper, copper ore, and minerals con-

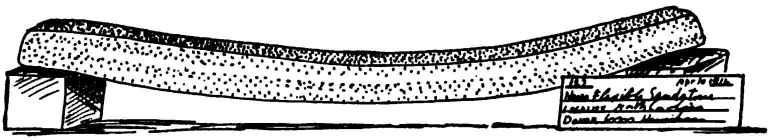

Fig. 1

taining copper in still another; and so on with each class or group you may have. When a rock or ore is composed of several minerals it is a good plan to exhibit a piece of the rock in company with small specimens of its various constituents. Thus granite, which is composed of quartz, feldspar, and mica, with small crystals of tourmaline or hornblende, should have smaller specimens of these various minerals beside it. Mica can be exhibited in the natural block, with a few thin pieces flaked off to show its transparency, and mounted over a piece of print. Calcite in its square, transparent form has the remarkable property of double refraction—that is, any object seen through the mineral appears double. For this reason a specimen of calcite with a card or paper with ruled lines beneath it, leaving about half the card projecting beyond the calcite, will illustrate this peculiarity perfectly (Fig. 2).

The majority of your minerals can be exhibited without

[redacted]

Fig. 2

Fig. 3

Fig. 4

MINERAL SPECIMENS

special mounts or without cases, but rare or small things should be protected from loss or injury.

Small crystals may be placed in bottles or vials with cotton, or placed on beds of cotton in trays or glass-covered boxes, or they may be fastened with plaster, cement, or shoemaker's wax to mounts of stiff cardboard. Transparent crystals show to best advantage on dark backgrounds (Fig. 4), and plain dead-black cardboard or painted wood will serve as mounts for such specimens.

Each mineral and rock must be labeled with the name, locality, and date of collection, and if composed of several substances a list of these should be added. If the material is of value, as a gem or commercially, it is interesting to state the fact. The following example shows how such labels may be filled out.

No. *136* **Date—***Dec., 1911*

Name—*Sulphur ore*

Locality—*Sicily*

Collector—*Exchanged*

Composed of—*Native sulphur and gypsum*

Uses—*Gunpowder, bleaching, medicine, sulphuric acid*

A very interesting exhibit of rocks, minerals, and ores of commercial value may also be prepared by showing the natural ore or rock and the various products or articles made from it. Thus, the sulphur in its gypsum, or silica, rock

may be shown, and with it the crude brimstone, a bit of roll sulphur, some sulphur flowers, powdered sulphur, and a bottle of sulphuric acid. The same idea may be carried out with any of the ores; and building or ornamental stones, such as marble, granite, and onyx, may be shown in blocks with one side in its natural state and the other cut and polished. The object of all collections and museums is to teach something, and actual specimens will convey a much clearer idea of the subject and will teach the observer more than pages upon pages of descriptive text, even if supplemented by good illustrations.

Chapter XXX

FOSSILS

FOSSILS, minerals, and rocks are very closely associated, and usually the mineral-collector will find many fossils in his rambles and the fossil-collector will run across numerous minerals while looking for specimens in his own line.

As the same tools are required for collecting fossils as for minerals, the collection of both groups should be combined, and if in charge of two different boys each may add much to the other's department in this way. Many boys, and grown-up collectors as well, are apt to scoff at fossils and think them uninteresting and unworthy of notice, but in reality such people only show their own ignorance.

If fossils had never been studied or collected we would know very little indeed about the past history and formation of the earth, and would be unable to explain a great many things in science that we now understand thoroughly. Moreover, our homes are heated, our steam machinery operated, our railway-trains run, and our steamships sailed across seas by the use of fossils, for coal in its various forms is merely fossil peat-bogs. The boy who is interested in birds, animals, insects, or reptiles will find fossils a most fascinating field, for every one of these branches of the

animal kingdom is represented in fossil form, and in gigantic and marvelous shapes far more wonderful and peculiar than any living creatures.

In some districts fossils are very common, and this is especially true of localities where limestone rocks abound. Many of these rocks are completely filled with fossil shells, corals, sea-urchins, and various other forms of ancient marine life (Fig. 1), or with strange plants and insects that existed countless ages ago. Some of these fossil-bearing limestones are very handsome when polished, and

Fig. 1

Fig. 2

this process often brings out the texture and construction of the corals to excellent advantage (Fig. 3).

Where fossil shells are common you can often find very perfect specimens, and some of these are just as clean and well

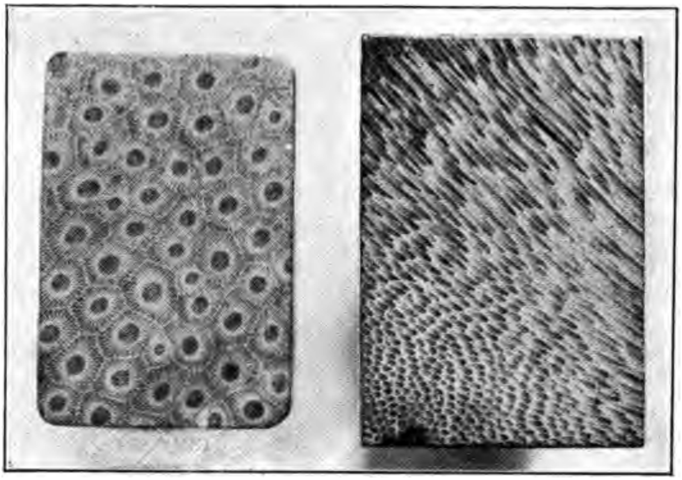

Fig. 3.

Fig. 4

Fig. 5

defined as the dead shells of existing species, at times even showing traces of the pearly lining to the shells (Fig. 4). At other times the shells themselves have entirely disappeared, and the clay or mud that once filled them has been turned to stone and forms a rocky cast exactly the size and shape of the shell itself. Fossil sea-urchins are often found

in a beautiful state of preservation, and if the rock surrounding them is soft the harder fossils often wash out and are found clean and perfect (Fig. 5).

Many species that are rare or extinct to-day or that only occur in the deepest portions of the sea are found in fossil form on our Western plains or high up on hill-tops, proving conclusively that at one time the great plains were covered with a vast inland sea. Among such things are the fossil species of nautilus and the related mollusks known as ammonites. In these ancient oceans the fish and other creatures grew to immense size, and many of them were fierce, gigantic beings that must have been terrible enemies to the more helpless species. The soft bodies of these huge monsters are seldom preserved, but in many places we find great numbers of enormous fossil sharks' teeth (Fig. 2) that prove how large and powerful these prehistoric fish were and how puny and small by comparison are the largest man-eaters of the tropics.

In other sections of the country, especially in the Western states, numbers of fossil bones are found, with an occasional complete skelton of stupendous fossil reptiles. These great creatures were slow, stupid, lumbering beasts that had scarcely any brain, and were sometimes protected by great scales and bony armor-plates. They were strange and weird in form, and bore no resemblance to any living thing, and ages and ages before man or the higher animals appeared upon the earth they disappeared and became extinct, owing to their own stupidity. Fierce active smaller reptiles with sharp and knifelike teeth and superior intelligence preyed upon them and devoured their young, and gradually they

were destroyed and their place usurped by other forms of life.

These giant fossils are hardly suitable for the museum of the boy naturalist, for a single leg-bone or skull would occupy nearly the whole room, while a complete skeleton would fill

Fig. 6

Fig. 7

dozens of your cases even if not spread out, and would weigh several tons.

It is not improbable, however, that you may now and then run across a fragment of some fossil skeleton or a tooth of a mastodon or giant lizard, and such things are very interesting, and if properly identified they may be exhibited beside cuts of the restored skeletons of the creature. These are very numerous, and many pamphlets describing the queer creatures of prehistoric days may be obtained from libraries and various institutions. Some of our museums have life-sized restorations of the fossil animals, and these are well worth studying; but it is very difficult to believe that such creatures ever actually inhabited the earth, and were it not for their bones no one would credit such things for an instant.

Fossil fish are very common, and these always make very attractive and interesting exhibits (Fig. 6). Plants, leaves, fruits, nuts, and various other forms of vegetable life are common, and beautiful specimens of these may be obtained in or near hard-coal mines. You can scarcely break open a lump of shale in many mines without finding fossil leaves or plants of some kind, and frequently very perfect ferns are disclosed (Fig. 7). These vegetable fossils should all be saved and the best ones exhibited, as well as all the different shells, fish, insects, etc., that you may obtain. A form of fossil that is very common in many places, and that always proves a puzzle to young collectors, is shown in Fig. 8. These may occur free from other rock and look like piles of disks or lozenges, or at other times they may be found in limestone, either in little piles or scattered about. These

are really the jointed stems of marine animals known as crinoids, and several species are found to-day living in deep water. One of these is shown in Fig. 9, and you will notice how much the drooping head looks like a lily. For this reason they are known as sea-lilies; and, although they look so much like a flower, they are really animals, and belong in the same group with the starfish and sea-urchin.

Fig. 8

Fig. 9

Some species have long stems and are attached to the bottom of the sea, while others have no stem and swim freely about or crawl around on the bottom. In prehistoric days these crinoids were among the most abundant of marine animals, and in certain localities the rocks are completely filled with them in a fossil state. Beautifully preserved and perfect specimens are sometimes found, but the majority

are broken and mixed up, and the stems are far more abundant than the heads, or "blossoms." Along many river-valleys, especially in the valley of the Connecticut River, in southern New England, there are large deposits of fine red sandstone, and this rock often bears fossils of a very interesting sort.

In ancient times these hard sandstone rocks were the sandy beaches and flats of broad rivers, bays, and estuaries, and at low tides various great beasts wandered over them in search of small creatures left by the receding waters, or wended their way across the flat to drink from the river. Wherever they passed their feet sank into the soft, wet sand just as to-day your footsteps leave a perfect impression as you walk along a damp, sandy beach. Presently the tide rose again, or a heavy rain swelled the river, until it flowed gently over the flats, and the water, carrying fine sand and mud with it, covered up the sand-flats and the footprints with a layer of silt, or ooze. Gradually, as the ages rolled on, the sand hardened into stone, and the footsteps, protected by the silt dropped upon them by the water, remained unchanged; and now, hundreds of thousands of years later, we break apart the layers of stone and find the footprints as plain as if made but yesterday, with the marks of the pattering raindrops, the wavy ridges made by the rippling river's edge, the cast-up fish, and now and then a wind-blown leaf, all preserved and turned to everlasting stone (Fig. 10). Some of the animals that made these ancient footprints were reptiles with great, fleshy feet armed with strong, hooked claws; others were delicate, birdlike creatures with slender toes; while others were lumbering beasts that dragged them-

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selves along and left deep wallows in the sand. Such fossils tell a wonderful story to the naturalist, and help us to realize how ancient this world really is, and what marvelous changes it has undergone since animal life first appeared upon its surface.

Many fossils show how one form of animal merged with another form which nowadays is very distinct. Thus birds to-day seem very different from lizards, and yet in prehistoric times birds existed which had teeth in their jaws and a lizardlike tail with feathers along its sides, and lizards oc-

Fig. 11

Fig. 10

Fig. 12

curred that had feathered tails, feet like a bird's, and that flew from place to place. One of these odd intermediate forms is shown in Fig. 11. Much of our present knowledge

of the development of animal forms and the relationship of widely different groups has been gained by the discovery and study of the remarkable remains of fossil creatures. A great many of these have been found, but new ones are constantly appearing, and you never know when you may stumble upon some wonderful fossil that will prove a revelation to students of natural history.

If a fossil is found in hard rock, care must be taken to cut out enough of the surrounding stone to prevent all risk of injury to the fossil. After the block is cut out it may be trimmed down, squared, and cleaned at leisure, and if you do not possess the tools for cutting and working the stone you can take it to some marble-yard or stone-cutter and have it trimmed and cut to a smooth and shapely form very cheaply.

Usually fossils that occur in rock of any sort are more or less covered and concealed by the stone itself, and before the specimen is fit to exhibit this must be removed. To do this requires time and patience and no little skill and practice, for, while many kinds of stone, such as red sandstone and shale, will flake away readily and in layers, other kinds must be cut and chipped off in minute bits. The only tools required are a small hammer and an assortment of cold-chisels, while a bag filled with sand should be used on which to rest the fossil or rock. Place the fossil-bearing block face up, and with chisel and hammer chip off bits of the rock until the fossil is clean and fully exposed. If there is but slight contrast between the color of the fossil and the rock itself, try wetting it; this sometimes brings the fossil out in strong relief and renders the cleaning process very easy. At other

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times the fossil has a tendency to flake off with the stone, and if this occurs you must work very carefully and save every piece carefully, and later on these may be cemented back in place with little trouble. After the fossil is well cleaned and free from the rock the surrounding background of stone should be chiseled and worked down until smooth and even, as illustrated in the fossil fish shown in Fig. 6.

Many fossils, when exposed to the atmosphere, become very brittle and fragile. Such specimens should be covered with glue or with thin plaster of paris before disturbing them, and when safely at home in your workshop they should be embedded half-way in plaster, and the temporary coat of glue or plaster carefully removed, leaving the plaster bed as a mount. Bones are often treated in this way, and many of the rarest specimens can only be preserved by this method. At times you will find fossils so large or so firmly embedded in hard rock that you cannot preserve them, and in such cases you can make a plaster mold of the fossil just as found, and later on you can make exact reproductions of the original by plaster casts. Badly broken fossils may be repaired by gluing or cementing them together and embedding in plaster blocks, and if the plaster is roughened with a chisel or similar tool and tinted a soft gray it will look almost like the real rock. If the fossil is large and is cracked and broken in several pieces when found it should be wrapped tightly in string, rags, or burlap, and the whole coated with plaster. The burlap or rags will prevent the plaster from getting into the cracks and breaks in the fossil, and the plaster will stiffen and bind the whole bundle together.

Small fossils may be mounted on little stands or pedestals of plaster, which serve to keep them right side up and at the same time prevent them from being knocked about and broken (Fig. 12).

Other small things may be glued or cemented to card or wooden mounts, while the larger ones may be merely laid in the cases or on the shelves, or they may be inclosed in neat wooden boxes made just to fit them. Very delicate or fragile things should be protected by a glass cover to exclude air and dust, but as a rule fossils, when once prepared, are very safe from injury.

You may have considerable trouble to identify some of your fossils, but you will be able to recognize insects, crustaceans, fish, shells, and footprints at once, and you can usually identify other things by comparing them with similar specimens illustrated in books or exhibited in some natural-history museum.

Part VIII

INDIAN RELICS

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Chapter XXXI

HUNTING RELICS

MOST boys are interested in Indian relics; and, as these are found in all parts of our country and are always of value and interest, they should be given a prominent place in the boys' museum.

Indian relics bob up in the most unexpected localities, and it is usually mere guesswork to try to select a likely spot in which to search for them. Some of the most perfect implements I have ever found were lying exposed in roadways, along railway tracks, in plowed fields, and in the beds of brooks.

Freshly plowed fields are usually an excellent collecting-ground, especially if in a district where battles between Indians, or between Indians and white men, were once fought. In such places the plow will frequently turn up dozens of beautiful arrow, spear, and ax heads, as well as the remains of old guns and pistols, sword-hilts, and bullets which have been lying beneath the surface for a couple of hundred years or more.

At times you may be able to locate the site of a former Indian camp. Such spots are usually on fairly high land

not far from water, and may be recognized by clam or mussel shells, bones, bits of quartz or flint, etc., scattered through the earth. Such localities usually yield very rich finds in old arrow-heads, hatchets, broken pottery, and similar objects. The spot where some arrow-maker camped may also be located at times by the numerous quartz and flint chips on or near the surface of the earth, and by searching carefully among this rubbish many perfect, or nearly perpect, arrow and spear heads may be collected.

One such spot that I found yielded nearly one hundred arrow-heads, not one of which was absolutely perfect, but which illustrated wonderfully well the process of manufacture by the long-dead artisan, as well as the imperfections which he considered rendered them valueless.

River-banks near the sea, or even the bluffs of the shore, often show great quantities of old rotten clam and oyster shells in the earth. These indicate the sites of ancient Indian camps, and are known as shell-heaps, or kitchen-middens, and if thoroughly searched will usually reveal numerous relics. The Indians were rather careless house-keepers and frequently threw out dishes, pots, tools, and weapons with their rubbish, which was fortunate for the collector of relics.

These shell-heaps are sometimes of vast proportions, and at certain spots in Massachusetts and Connecticut they extend for miles along the shores and are from ten to fifty feet in thickness. Of course, it is impossible to search thoroughly such huge heaps of material, but after heavy rains or storms one may often find numerous arrow-heads, spear-heads, and similar objects washed out from the shell-

heaps and lying exposed on the beach or ground at their base. Where the shell-banks have been exposed to the waves for many years you may find many arrow-heads among the pebbles and stones of the shore, but, as a rule, such specimens are badly wave-worn and have become so rounded and smoothed as to be scarcely recognizable.

If an old Indian grave or mound can be located it will always yield fine specimens, for, as a rule, the Indians buried their dead surrounded with weapons and implements. In Ohio, Indiana, and various other middle and Western states there are large numbers of these mounds, many of which have been opened and destroyed. The importance of the mounds is now quite generally recognized, and most of the larger ones are under state protection, but there are usually lots of them scattered about that are not known or protected by law, and if you excavate these systematically and with care you will help rather than hinder the research work of other archæologists. Whenever you find a new grave or mound you should make careful measurements and sketches—with photographs, if possible—showing the location, shape, points of the compass, height, width, length, etc., and as you dig into it you should note exactly how the earth is arranged—whether in layers of earth and sand, sand and ashes, or clear earth or sand—and when you reach the contents you must work with great care. Notice just where and how the various relics are placed and the order in which they occur, and if a skeleton or bones are found make careful sketches as to their position and the direction in which the body faced when buried. All this makes the relics more valuable and interesting and serves to throw more

light upon the lives and customs of prehistoric men in America.

In many districts the cliffs and rocks and even boulders are carved or decorated with grotesque and strange figures which have endured for many centuries, and, while these cannot well be collected and transported to the museum, they may be exhibited by means of photographs or casts. If they are in relief, or deeply cut in the rocks, and are within reach, you may easily make plaster molds and reproduce them by colored plaster casts for exhibitions, but if they are merely paintings or out of reach or of very large size, they should be photographed. At times the figures are either very lightly cut into the rock or are painted in dull ocher or red that will hardly show any contrast in a photograph. Such specimens may be brought out by rubbing white clay on the rock surrounding the figures. Chalk may be used, but the clay rubs or washes off much easier than chalk, and you should always try to leave these historically valuable inscriptions in as perfect and natural condition as you find them.

Chapter XXXII

ANCIENT AND MODERN RELICS

TO most people Indian relics consist entirely of old arrowheads, ancient pottery, and similar objects, but in the broadest sense Indian relics include anything and everything made or used by Indians in their home life, arts, wars, or hunting; and, as the primitive Indian is fast disappearing and real Indian things are becoming scarcer every year, your collection should contain modern as well as ancient tools and implements, clothing, baskets, and in fact every object made or used by any tribe of Indians or Eskimos.

Many of the buckskin clothes, moccasins, leggins, pouches, and similar things are even now very scarce and hard to obtain, and real Indian beadwork is very valuable as well as beautiful. Of course, a great deal of beadwork and buckskin can be obtained, but much of this is made by white people in regular shops or factories in imitation of the real Indian work, while still more is actually made by Indians merely to sell, and is turned out as rapidly and cheaply as possible. In this class of work cheap cotton thread has replaced thongs and sinews, soft-tanned cowhide, kid, and sheepskin have replaced the beautifully tanned and smoked

buckskin, and aniline dyes have furnished the colors that in the old days were produced by barks and berries.

Practically all Indian bead and ornamental work told a story, and the totem, or sign, of the tribe, family, and individual usually appeared in the pattern. Each tribe had moccasins of distinct style or pattern, and a collection of moccasins is a very interesting exhibit. Head-dresses, war-bonnets, "skull-breakers," tobacco pouches, belts, knife-sheaths, pipes, necklaces, amulets, and all such objects are highly interesting and valuable, and every genuine Indian relic will increase in value as the years roll on.

Many tribes still produce objects in which the influence of the white man scarcely shows, while others combine various products of civilization with savage art and native products. Thus the Indians of Central America prize monkey teeth and jaguar teeth very highly, but they value shoe buttons and tiny brass clock wheels fully as much, and as a result their necklaces are most interesting combinations of pierced teeth and odds and ends of junk picked up in the settlements (Fig. 1). Bells of any kind were always favorite objects with the Indians, and practically every collection of buckskin garments and ornaments will show various bells used in the decorations. In place of real bells the Indians often employed bits of tin, bent in conical form, around the fringes of their garments, and these tinkled as they moved and gave forth sounds quite similar to tiny bells. Fig. 2 shows a buckskin pouch with fringe ornamented with these tin cones. Where a tribe is far from any settlement and can rarely obtain any civilized goods their products seldom show any influence of the white man's presence, and among the

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Fig. 1

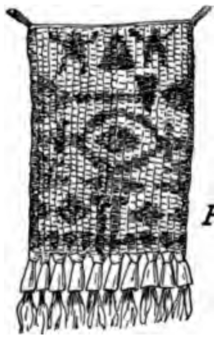

Fig. 2

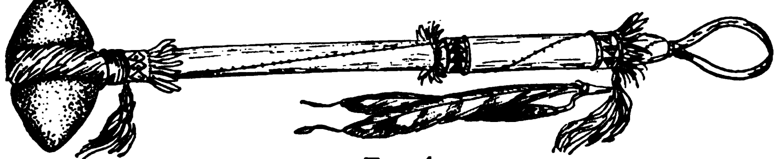

Fig. 4

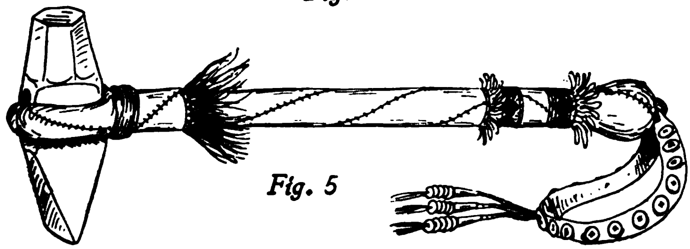

Fig. 5

Eskimos every bit of wood, metal, or other material from civilized or temperate lands is so valuable that they seldom use anything but native material, save where absolutely necessary, and have become very adept in carving bone, ivory, and stone. They are very quick to note the superiority of any civilized product, however, and wherever possible they save time and labor by using bits of cloth,

metal, and beads. In the illustration (Fig. 3) an example of Eskimo handiwork is shown. This is the work-basket of an Eskimo woman, and consists of a needle case of wood (A) which is worn around the neck by the straps (B). Below the needle case is a strap bearing a spindle (D), over which the thimble (E) is slipped, and to which the hair comb (F) and a bodkin (G) are tied by sinews. The needle case is carved from a piece of driftwood, and is provided with a wooden stopper which the wearer may extract with her teeth when both hands are in use. The straps that hold the affair around the neck are made from the lining of a cast-off whaler's coat, and the white bead ornaments are sewed on with fine reindeer sinew. The thong below the needle case is a strip from a pair of old dungaree overalls sewed and ornamented with beads, the thread used being fine sinew. The spindle at the end is built up of alternate layers of whalebone and walrus ivory beautifully worked, and the comb and bodkin are also carved from ivory. The slender, flexible needle (H) is worked out from the leg-bone of an arctic hare, and the thimble is formed from a single piece of walrus-hide. Thus, you see that what at first sight may have appeared a very ordinary and uninteresting bit of savage toggery proves on examination to be full of interest, and furnishes a good idea of the resources and skill of the inhabitants of the frozen north, and in addition illustrates the influence of civilization on savage or primitive people.

The "skull-cracker" (Fig. 4) is another example of utensils or weapons that illustrate the progress and character of Indian tribes. In this we find the heavy stone ax

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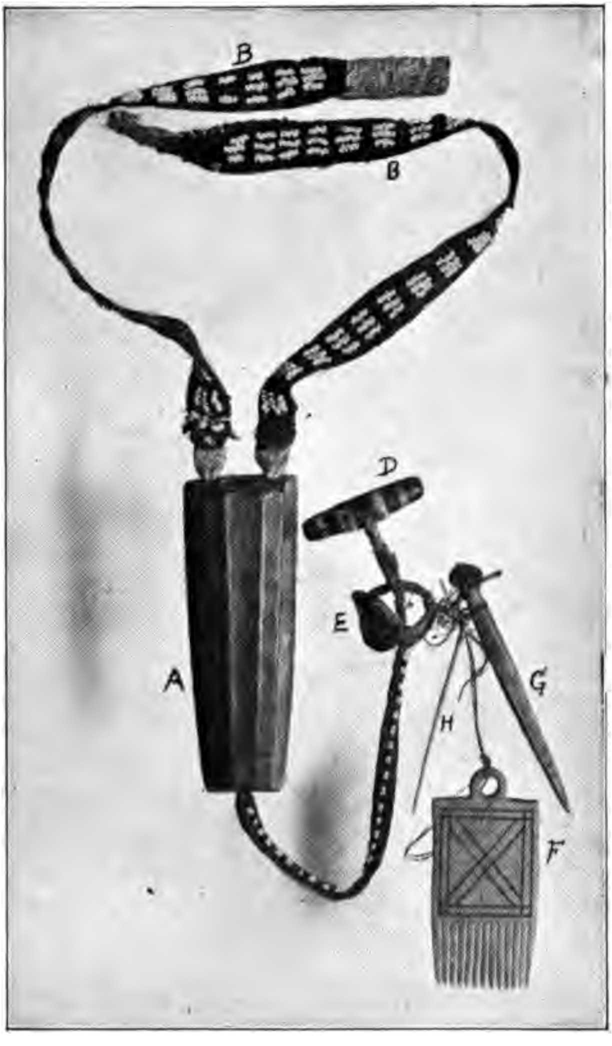

Fig. 3

ESKIMO SEWING-CASE

or club of the prehistoric Indian attached to a strong handle covered with rawhide and buckskin and highly ornamented with beads, fringes, eagle feathers, and scalps. The whole shows that the Indian who used or made it was still partly in the stone age, but had become familiar with the higher arts of tanning skins and had begun to avail himself of the white man's goods.

Compare this weapon with that shown in Fig. 5. In this battle-club the stone mallet of the stone age has been discarded in favor of a miner's hammer, but the method of attaching it to the haft, the character of the latter, and the barbaric decorations remain similar. The tuft of human hair around the handle may very probably have been torn from the head of the poor prospector from whom the hammer was taken, and the bone buttons sewed as ornaments on the wrist thong show that the owner of this club had his own unique ideas of decorative art.

By studying such objects you may learn a great deal of the history of the American Indian, and by collecting implements of peace as well as those of war and the chase a still further insight into aboriginal ways may be obtained.

Baskets are very interesting objects, and many of those made by the Californian Indians are exceedingly beautiful, while the sweet-grass baskets of the New England Indians are well worthy of a place in your collection. Some tribes of Indians were very expert basket-makers, and many of the most beautiful and best baskets found in modern stores are made by full-blooded Indians. In the very heart of New York City there is quite a large colony of Mik-Mak, Passamoquoddy, Mohawk, and other Indians who make a very

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good living by basket-weaving for the department-stores. As a rule these baskets possess no individuality whatever, as they are made to suit the white man's purposes and demands, but in many places Indians still make baskets peculiar to their tribe.

The few remnants of the once warlike and numerous Carib Indians in the West Indies weave beautiful baskets of palm and banana leaves. These baskets are absolutely

Fig. 6

water-proof, and will hold water as well as a pail or bucket. They are made in all sizes, from a few inches to several feet square, and are used as trunks and traveling-bags by the natives (Fig. 6).

A small Navajo blanket or saddle-cloth, a Pueblo or Zuñi belt or bridle with its rough silver and turquoise ornaments,

Sioux and Blackfoot beadwork, Ojibway embroidery in porcupine quills, and, in fact, typical examples of the handiwork of as many different tribes as possible should be included in your collection, not forgetting a model birch-bark canoe and a model dugout if they can be obtained.

Chapter XXXIII

COLLECTING AND EXCHANGING

NO matter where you live, you will soon discover that the local Indian relics are limited in number and variety, for even if you live right on an Indian reservation you will be obliged to confine yourself to the articles made and used by the tribes near by.

Of course, if you are fortunate enough to travel about you can pick up and collect an immense variety of Indian things, for there is scarcely a spot in the Western Hemisphere that was not once inhabited by aborigines, and wherever they lived they have left relics or ruins behind them.

Even in Europe stone weapons and implements, carvings on bone, and various other objects may be found, while in the South Sea Islands, the Philippines, and, in fact, everywhere one goes, primitive tools, implements, and products may be collected; and all of these may be included in the exhibit of Indian relics to illustrate the differences in the skill and requirements of various savage people.

If you do not travel about you will have to depend largely upon exchanging or purchasing relics and specimens from other localities, and I do not know of any one class of specimens that is more widely exchanged by collectors

than Indian relics. As all the stone implements were chipped from stone by hand, no two are exactly alike, no matter how skilful the maker may have been, and for this reason you need never fear that you will have any duplicates.

It often does happen, however, that a collector has a number of objects so similar in appearance, color, size, and material that many of them may well be spared for exchanging. As the materials used were usually obtained locally, the implements made in one district are generally a pretty fair indication of the prevailing rocks and conditions, and a boy in Oregon that has quantities of tiny agate bird-points may be very glad indeed to exchange these beautifully formed heads for crude and rough spear-heads from the Atlantic-coast states.

In the old Indian days each tribe traded more or less with neighboring tribes, and Indians living in a district that did not produce any suitable stone for their weapons were obliged to obtain the crude material or the finished objects from other tribes either by trading or by conquest.

This led to certain materials and implements being found to-day far from the spot where they originated, and this has frequently puzzled the amateur archæologist. The red pipestone so highly prized by the Indians was found only in the upper Mississippi Valley, and this material proved a splendid medium of exchange throughout the length and breadth of the country.

The tusk shells, or dentalium, found only on the Pacific coast were greatly valued for ornamental work, and these passed back and forth among the Western tribes, and at times even found their way to the middle and Eastern states.

Flint, quartz, or hornstone occurred nearly everywhere, and the majority of stone implements found are made from one of these minerals, but in the hard, sharp, glasslike obsidian of the western and southwestern volcanic districts the natives discovered a far better material for their weapons, and whenever, by prowess or barter, another tribe obtained this material or weapons formed from it they realized its superiority and used every endeavor to obtain more.

In those days, however, intercourse between the various tribes was difficult, and tribal wars were constantly waged, and it doubtless required years for a material or implement made in the western districts to reach the tribes dwelling in the central part of the continent.

As the original natives depended upon trading their products with distant tribes in exchange for objects they could not obtain otherwise, so to-day the collector of Indian relics must depend upon exchange in order to secure anything approaching a complete collection of the Indian implements of the United States, and if you have never seen or collected stone relics from any part of the country except your own locality you will be greatly surprised at the almost endless variety of shapes, materials, and sizes that a large collection exhibits.

From the northwest come the beautiful bird-points of handsome agate, showing splendid workmanship and great skill in arrow-making; from the southwest are obtained glistening black or dark-green spears, lances, and daggers of razor-edged volcanic glass; polished tomahawks, mauls, axes, and stout spear-heads are found in the central states, with dangerous-looking arrow-heads of dark hornstone,

jasper, and flint; while on the Atlantic seaboard the bulk of the weapons are of snowy-white quartz, crudely made, often one-sided, and evidently the handiwork of a race not highly skilled in the art of stone work and struggling to produce the best results they could with a hard and refractory material to work with.

If you can possibly manage to exchange articles common in your locality for other articles that are rare or difficult to obtain, but which may be common elsewhere, you should by all means do so. A collection of stone weapons, even if very complete, is not one-half so interesting or educational as a collection that embodies stone implements, ornaments, and pottery.

Pottery includes all vessels and dishes made from clay, and is usually very highly prized by collectors, for nearly every savage tribe, no matter how primitive, managed to fashion stone weapons of some kind, while the art of making clay dishes and baking them to form earthenware indicated the dawning of civilization.

Pottery from various localities and various countries is advisable, and even if mere fragments are all that you can obtain such pieces will be far better than none.

Among the North American tribes pottery was comparatively rare, especially in the Eastern states, and even that obtained from the middle and Western states is rather crude and dull-colored. Once in a while, however, a splendid piece of Indian pottery is found intact, but by far the greatest number are badly broken. Pots and dishes were hard to make, and were probably valued highly, and were not discarded until broken or cracked beyond repair. An example

of the care taken by the Indians to save their earthen vessels is shown in a large pot found by a friend in New England. This was evidently intended for holding grain, corn, or other dry material, and in baking or finishing the vessel it was

Fig. 1

cracked on one side. To hold the two pieces firmly together the savage owner pierced holes along the edges of the crack and evidently laced it together with thongs or roots, for the pot to-day shows the holes with the sides slightly worn where the thongs chafed against the clay by the slight motion of the broken edges.

Another very large and perfect pot was found in an open field, bottom-side up, by a farmer, who at first took it for a stone. Undoubtedly, this vessel was originally buried to prevent it from falling into the hands of enemies; or perhaps the owner was compelled to leave his home and was unable to carry the cumbersome pot along, and so buried it until he should return to claim it. In the first case the owners of

the pot may have been massacred and the pot remained forgotten for centuries; or, in the second place, the owner may have been killed or captured on his journey and never returned to resurrect the household utensil he valued so highly. Such things bring up many thoughts of the old Indian days and frequently create an intense interest in the early history of our country.

Although pottery in the north and east was rare and valuable and is seldom found, yet in South and Central America and Mexico pottery is the commonest form of

Fig. 2

Indian relics. In certain districts in Central America, notably in Costa Rica and northern Panama, there are vast numbers of prehistoric graves, every one of which contains

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beautifully formed and brightly colored pots, vases, cups, dishes, and similar utensils (Fig. 1).

Great numbers of these graves have been ruthlessly destroyed in the search for gold ornaments often found within them, but a great many yet remain untouched.

This Central American pottery has remained as fresh and bright as the day it was made, although countless centuries have passed since it was buried with its makers and owners; and, in fact, no one can even guess at the length of time which has elapsed since these graves were first dug and the deceased placed within, surrounded by his household gods and utensils. For all we know, they may be as old as the pyramids, or even older, for the men who made them were skilled in many arts, and have left immense ruins of carved stone, huge carven monoliths, and well-planned cities as did the Egyptians, and, like the latter, they covered their handiwork with hieroglyphic carvings relating their story (Fig. 2). Unfortunately for us, these writings are still unintelligible, for no one has yet discovered the key to their meaning, as was accomplished by the discovery of the Rosetta Stone, which opened for us the long-closed history of Egypt.

Chapter XXXIV

ARRANGING THE COLLECTION

THE arrangement of your collection of Indian things should be either by tribes or by localities, or, better still, a combination of the two. Your old stone relics must be arranged by states, for you cannot, of course, be sure of the tribe that produced them. By devoting a certain case or part of a case to each state from which you have specimens you can then exhibit the more modern objects from the same state near them, with a label indicating the tribe to which the articles belonged. Another method is to divide your collection of ancient relics according to states or localities and make a separate exhibit of modern things, arranging them by tribes.

Very little preparation is required for Indian relics, but such objects as arrow and spear heads show to best advantage and occupy the least space when mounted on stiff cards by fine wires passed through holes in the mount and over the specimens, as illustrated in Fig. 1. In this way all the specimens from one grave or mound, or from one shell-heap or camp-site, may be easily kept together and cannot become mixed. Heavy objects like hatchets, axes, etc., may be placed directly on the shelves or on the floors of the cases,

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but pottery, beads, and fragile objects should be placed in glass-covered boxes or cases on a bed of cotton.

Buckskin articles, or any object in which buckskin, feathers, hair, or animal matter of any sort is used, must be placed in cases with mothalene, for moths and buffalo-beetles will soon ruin such things if left exposed.

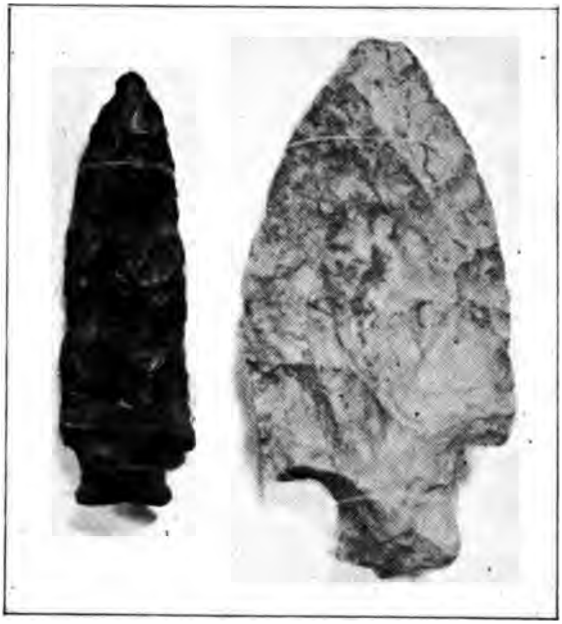

Fig. 1

You will often find that it is a very difficult matter to classify your stone implements, for, while arrow and spear heads, axes, mauls, mortars, and pestles, and many other objects are so easily recognized that there is no question as

to their use, other things are so peculiar in shape or of such a doubtful character that you cannot imagine the purpose for which they were intended.

Even the most advanced students of prehistoric stone implements are often at a loss to name certain stone objects, and many other things are named or classified by mere guess-work. Doubtless the makers and users themselves considered such objects as perfectly adapted to their needs, but the modern man, accustomed to highly perfected tools, cannot tell with certainty whether a rough-edged flint was intended for a knife, chisel, or scraper or a rounded and smoothed cobble was a hammer, grinder, or club. Many of the stone relics were no doubt used as ornaments, for they are often pierced for a thong or string, and similar objects have been found resting upon the breast of the skeleton, or with shell or stone beads still in place on either side, indicating that the disk of stone was a sort of brooch or locket on a necklace of beads. A great many books and pamphlets have been published in regard to Indian relics, and when in doubt about anything you may find or exchange you had better look over these works. In most cases all peculiar or rare forms of relics are illustrated, and similar ones may be readily identified. If near a large museum, you can easily compare your specimens with those on exhibition, but if you cannot classify the object by either of these methods you can determine its name and use, if known, by sending a sketch, photograph, and description to some competent archæologist, or to the curator of the archæological department of any museum. Sometimes the specimen you have may be so interesting or unique that the authority you ask

about it will be very glad to give you a number of more common relics in exchange. Under these conditions I should certainly advise the exchange, as for your purposes a number of interesting objects that will enable you to complete a good part of your collection is of greater value than a single odd specimen of greater rarity, but which may not be of any general interest or value because it is of unusual form or workmanship.

In nearly every amateur collection of relics there are a number of pieces of stone which are not real relics at all, but merely broken, worn, or chipped rocks that somewhat resemble genuine Indian relics. At times it is really difficult to distinguish between real relics and natural stones, but an examination of the former will usually reveal marks of chipping or hammering or spots showing wear and use. Stones found in streams and on beaches often assume rounded forms that resemble mortar pestles or mauls, but, as a rule, these will prove to be worn irregularly and are one-sided. It is better, however, to preserve a worn or broken stone that may be a relic than to throw away a relic that you think may be merely a stone. Some of the earliest stone implements and weapons are so much like ordinary stones and rocks that no one but an expert could distinguish them, for of course the earliest man merely used a natural stone for a hammer or club and a broken bit of flint or slate for knife or arrow-head. He naturally selected the pieces best suited to his purpose, and when it dawned upon his savage brain that he could improve the rough stones by breaking or chipping them in certain shapes his first attempts were very crude. If you stop to consider this point you will

realize that there must be every gradation in quality and workmanship of stone implements from the original stone or rock that was merely worn away by use to the beautifully finished objects that were produced by people far advanced in arts and civilization like the Aztecs, Incas, and other races. Some of the South Sea Islanders still produce very beautiful stone axes and hammers, but, as a rule, all races to-day that make stone implements or weapons make them to sell to tourists. This is the case with the Sandwich-Islanders, but in South America certain tribes still use stone weapons and some of these Indians make very beautiful arrow-heads out of old beer bottles!

The stone relics obtained on old battle-fields and the various implements of the more modern Indians are so intimately associated with the early settlers and pioneers that bona fide relics of our ancestors may be exhibited with those of their red-skinned friends and enemies. Old flint-lock guns, blunderbusses, bullets from battle-fields, old horse-pistols, ancient swords, and old weapons of any sort belong properly in this class, but it is not advisable to attempt to include tools and implements of household use or peaceful pursuits. Such things are obtainable in great variety, and should be classified among antiques rather than relics. The only object in collecting the ancient weapons is to illustrate the vast superiority of the white man's weapons over those of the Indians he fought. In Florida, Mexico, and the southwest, as well as in the West Indian islands, ancient Spanish armor, Toledo blades, and helmets are often found associated with stone arrow and spear heads and axes, and at times helmets and breast-plates are even

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found with the crude stone weapons still embedded in the iron. Of course, such things should invariably be shown together, for they illustrate in a most graphic and striking manner the tragic and bloody warfare waged between mail-clad cavalier and naked savage, and will carry the observer back to the days of Cortez, Pizarro, De Soto, and their fellow-conquistadores.

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Part IX

THE BOTANICAL COLLECTIONS

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Chapter XXXV

THE PLANT COLLECTIONS

AS a rule, collections of plants, flowers, and other botanical specimens are of slight value for exhibition purposes, as they are fragile, usually faded, and show so little of the real appearance of the living object that they are only suitable for study by those interested in botany.

Moreover, the number and variety of plants, even in one small region, is so great that an entire room would be required in order to exhibit even a part of the local flora.

Nevertheless, a collection of botanical specimens, selected and prepared to illustrate certain important points, or showing plants of economic value, can be made interesting, attractive, and very valuable. The most important and useful subjects to collect and exhibit in a boys' museum are the trees, woods, flowers, fruits, fungi, and grasses. It is quite feasible and easy to collect all the woods found in your locality, and a good collection of woods is highly valuable and is probably the most important part of any botanical collection.

Fruits that are native are seldom of interest, as they are

familiar to every one, but specimens illustrating the natural appearance of foreign and tropical fruits used in the arts and manufactures are interesting and attractive. Flowers are mainly of interest when of economic or industrial value, or as supplementary exhibits in connection with the woods or fruits. Fungi include all the toadstools, mushrooms, and similar growths and are of considerable interest, but they are very difficult to prepare, and artificial reproductions are seldom very perfect. Grasses are easy to prepare, and as they are of great importance to agriculture, they are advisable as illustrating the various grasses occurring in a locality.

In a great many cases good photographs or colored drawings will represent a certain plant, flower, seed, or leaf far better than a preserved specimen, and such photographs are very important in connection with the wood and tree collection or with exhibits made to illustrate the commercial value and process of some vegetable or plant.

When using photographs in connection with museum exhibits the prints should be made on a good black-and-white, mat-surfaced paper, preferably platinum. Gold or silver papers will fade in time, and in cases where exposed to the various salts, chemicals, and other substances used on the specimens they will often discolor very rapidly. Platinum prints will not fade or discolor, and mat-surface prints should be used rather than those with a glossy surface, as the reflection of light on the latter often prevents the picture from being seen to advantage.

Flowers, plants, grasses, fruits, woods, and other botanical specimens must be collected according to the season in which they occur, bloom or fruit, and when collected they may be

prepared and put aside until you have spare time for mounting and arranging them. Many people seem to think that the preparation of botanical specimens is very easy, and that such specimens are free from attacks of museum pests. This is not the case, for the collection and preparation of botanical subjects requires careful and painstaking work and careful labeling, while their identification is oftentimes extremely difficult. Museum pests often destroy specimens of plants and woods, for while they are free from moths and buffalo-beetles, yet the tiny book-lice, minute boring-beetles, and numerous other insects will eat up and destroy a large number of specimens in a very short space of time.

Fortunately, flowers and plants require but few appliances for their preparation, the most important things being a number of sheets of botanical drying-paper, or clean blotting-paper; sheets of smooth, white paper or thin Bristol-board; a plant-press and some glue. For collecting you will require a tin box (the regular botanists' tin cans are best), a trowel, a knife, and an old blank-book.

The use of botanical drying-paper is not essential, as the blotting-paper will answer every purpose, and even newspapers will work well. The flowers and plants are merely placed between the sheets with leaves and stems arranged to best advantage, and the whole placed in a press or under heavy weights. An old letter-press is a very good thing to use, but a board with weights on it or a pile of books will answer every purpose. The sheets of drying-paper should be frequently changed for fresh dry ones until the specimens are thoroughly dried, and the final result as to color and perfection of your pressed plants will depend in great measure

upon the frequency with which you change the papers. If the papers are warmed by a radiator, stove, or in the bright sunshine, it will help a great deal.

Endeavor to secure perfect specimens whenever possible, and, as a rule, try to get plants that will show roots, stems,

Fig. 1

leaves, and flowers in one subject (Fig. 1). When plants are pressed with the various parts in one specimen as illustrated, they give a far better idea of their peculiari-

ties than when each part is preserved and exhibited separately.

Many leaves and flowers will fade badly despite all the care you may take in drying and pressing them. This may often be avoided by drying them in a dish of very hot sand or by dipping them in a solution of formaline before pressing.

When the flowers and plants are thoroughly dried they may be mounted on white or tinted paper or cardboard by sticking them in place with tiny drops of glue, or, better still, fastened to the paper by small pieces of paper glued or pasted over the stems here and there. In all cases it will add greatly to the beauty and value of the specimen if a colored drawing of the flower is made on the mount with the pressed plant. These color sketches may be drawn directly on the mount, or they may be made on separate sheets and pasted on the mount afterward.

Grasses are treated in exactly the same manner as flowers and plants, and the use of each should be written on the label if intended to illustrate their value to mankind.

Fungi are very difficult to preserve, as before mentioned, but many species can be preserved in very good shape by drying them in an oven on a dish of hot sand. Others may be preserved by soaking in formaline before drying, while still others must be preserved in alcohol or formaline solutions.

As a rule, good photographs of fungi, colored by hand with water-colors, are more satisfactory than the real objects; or, if you wish, you may try your hand at making wax casts of the fungi exactly as described for making casts of frogs, snakes, fish, etc.

It is impossible to determine beforehand just which fungi will preserve and which will not, and the only way to find out is to try them all. The harder and firmer varieties are, as a rule, the easiest to preserve; but there are exceptions, and the evil-smelling whitish fungi sometimes found in gardens often make excellent specimens by soaking in formaline and drying.

In collecting fungi for specimens you should select those that are young, fresh, and firm, for as soon as they become old or start to decay you cannot do anything with them. As soon as collected they should be carefully wrapped in fine tissue-paper and cotton, for if bruised or scratched they will discolor and decompose very quickly.

Many of the drier species found growing on trees will make good specimens by merely drying in the air; but, as these are very apt to be eaten by tiny beetles and other insects, they should be soaked thoroughly in formaline before drying in order to destroy any animal life they contain.

Even with this treatment book-lice and other minute creatures frequently destroy the fungi, and to avoid this they must be kept in a case or box with camphor or naphthalene.

Seeds and seed-pods are often very odd and interesting in shape, and they are easily preserved. Most of the pods will dry and burst open under ordinary treatment, but if soaked in formaline and dried at a high temperature on hot sand this trouble may usually be avoided.

Many common plants have very interesting methods of distributing the seeds. Among plants of this sort are the dandelion and milkweeds. These have seeds provided with

fluffy or feathery appendages that enable them to float hither and thither with each draught or breath of air, and they are thus wafted long distances and spread their species over vast areas.

Any seeds that have peculiarities of this sort should be shown; and, although at first it may seem a difficult matter to preserve and exhibit them, it is not hard in reality. By pressing the plants and flowers and carefully preserving

Fig. 2

the seeds and pods you can make up very interesting and attractive exhibits by mounting all the parts together in a Dennison insect-mount as shown in Fig. 2. The Dennison mounts are very cheap, but if you wish you can easily make mounts that will answer every purpose by getting pasteboard boxes, fitting a glass cover to the box, and placing smooth layers of cotton within.

The specimen should be laid carefully on the cotton, the cover pressed down upon it, and the glass firmly bound to the box by gummed lantern-slide binding or passe-partout paper. Where the specimen is very light-colored or white, black cotton or colored cotton should be used, but for most cases the pure-white cotton is best. Only the finest quality cotton should be used, and it should be laid in the box in smooth, even sheets trimmed off with scissors to fit the box, and should fluff up some distance above the edges when the cover is removed.

These mounts are splendid for all sorts of specimens, such as plants, flowers, grasses, insects, marine animals, crustaceans, crystals, and, in fact, any small, fragile, or rare object.

Chapter XXXVI

THE FRUIT COLLECTION

FRUITS may be made into a very showy and interesting exhibit either by themselves or in connection with the tree and wood collection, but common fruits, such as apples, pears, peaches, etc., are so well known and of so little interest that it is scarcely worth while to bother with them, unless of unusual size or to illustrate certain varieties.

Fruits themselves cannot be preserved with success, but wax casts may be easily made which will answer just as well and cannot be distinguished from the real fruit without a very close examination.

For practice in molding fruits you had better select some fairly round, smooth, common thing, such as a pear or apple, and proceed as follows:

Clean the fruit thoroughly and embed it in a mass of clay, taking care that the clay extends up to the thickest portion of the pear and no farther (Fig. 1). Wipe off every bit of clay or dirt that has stuck to the exposed portion of the fruit, and build up a wall of clay nearly as high as the top of the pear. Mix some fine plaster of Paris and water, and stir it thoroughly until perfectly smooth and free from lumps and about as thick as good thick cream. With an old

spoon dip up the plaster and pour it evenly and smoothly over the pear until all parts are covered and the plaster fills the space formed around the fruit by the clay wall. By this time your plaster will commence to harden, or set, and you should continue pouring more plaster on to the top of the pear until quite a little mound has formed above it.

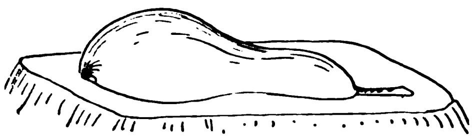

Fig. 1

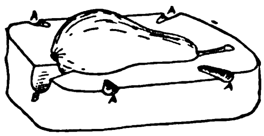

Fig. 2

Jar the plaster once or twice by tapping the table on which the mold rests with a hammer or other object, and then leave it undisturbed until the plaster is thoroughly hard. Now turn the whole mold upside down and remove the clay wall and clay bed, and you will find your pear embedded in a plaster matrix with half of the fruit exposed (Fig. 2). Place this on the table and cut two or three small notches around the edge of the plaster (Fig. 2, A) and cut a larger and deeper notch leading from the outer edge and reaching to the pear itself (Fig. 2, B).

Roll up a little cone of clay and place it in this groove so that half of it projects up from the plaster matrix, and then grease all the parts of the plaster edge thoroughly and rub a little grease on the pear, but be careful not to put enough on the fruit to fill the minute pores in the skin. Now build a wall of clay up from the plaster until it is as high as the highest part of the projecting pear, and pour in plaster

exactly as you did for the other side. When this is hard, remove the clay wall, pull gently on the two halves of the mold, and if your work has been properly done the two parts will come away and leave the pear in one of them. Work the pear gently until it comes out of the mold and leaves a perfect impression behind it. The little cone of clay must also be removed from the plaster, and any bits of clay adhering to the two edges of the mold removed. Examine the inside of the mold carefully, and if any small holes or imperfections show they should be filled with tiny pellets of clay pushed into them with the end of a soft-wood stick. Now place the two halves of the mold together and tie them firmly in place by wrapping string or thread around them.

Mix up equal quantities of hard paraffin, beeswax, a little Japanese wax, and some spermaceti or bayberry tallow, and melt them together and stir thoroughly. When well melted and hot pour a little on a scrap of the hardened plaster and let it cool. If it comes away readily and is tough, hard, and not brittle, the mixture is right. If it sticks and is too soft you must add more Japanese wax or bayberry tallow, and if too hard and crackly you must add more beeswax and paraffin. When the mixture is about right, stir in some green tube oil-paint or a little powdered green (chrome green is best) until the wax shows quite a little color, and after stirring it thoroughly pour into the plaster mold until it is about three-quarters full. Plug the hole left by the notch and the clay pellet with a piece of soft clay, and at once commence to turn the filled mold about in every direction and back and forth so that you are sure that the melted wax has reached every spot on the inside of the mold. Con-

tinue this motion until the wax in the receptacle in which it was melted has commenced to harden. As soon as this is quite hard you may be sure that the small quantity in the cold mold is also hard. Drop the entire mold into cold water and cut the threads or strings that bind it together. In a few minutes you may take out the mold, but it is better to wait at least half an hour. Then work the halves of the mold gently back and forth until a little looseness is felt, and then dip again in the water. Work very carefully, holding the whole under water, until one half of the mold comes away. The half of the wax fruit will now be exposed, and as this is hollow and very fragile, you must use great care in working it loose from the other half of the mold. You will finally succeed in getting it free, however, and you will be surprised to find that you have a light, hollow wax duplicate of the pear that only requires a little trimming and coloring to be so much like the original that it will be indistinguishable.

Where the two halves of the mold have come together there will be thin projections or "fins," and these, as well as any other irregularities, must be very carefully trimmed off with a sharp knife. Probably there will also be several small holes, imperfections, or indentations in the wax surface, and each of these must be carefully filled by heating a small knife-blade, dipping it in the wax, and carefully molding the soft wax into the hole. To color the wax fruit you can use tube oil-colors very nearly as they come from the tube, and by using a dry, soft brush or a tuft of cotton you can easily blend and shade the colors perfectly.

The only trouble you are likely to have in making these

hollow wax fruits is in the wax sticking to the molds when dried out old molds are used, or by finding that the wax has become unevenly distributed, leaving one side of the wax fruit very thick while the other is thin or wanting. In the first place the trouble may be avoided by always soaking old dried molds in water before casting the wax. The second trouble is due to stopping the motion of the mold before the wax is hard. Another fault that sometimes occurs is when the mold is too damp and the wax not hot enough, in which case the wax will form irregular layers and spots here and there. Sometimes, if too little wax has

Fig. 3

been poured in and the mold is dropped suddenly in cold water before the wax is hard, one side of the wax will contract and leave a hollow spot. In any of these cases you can remelt the wax and try again, but if the wax sticks to the

mold and breaks you will be obliged to make a new mold, and for this reason you should always dampen the mold every time you make a cast.

Various tropical and rare fruits may be reproduced in this way, and a collection of these unusual fruits is always interesting. Fig. 3 shows a group of wax West Indian fruits made as described, and these never fail to arouse interest in visitors to the Bronx Botanical Museum, where they are exhibited with a number of others made by the author in the West Indies.

The fact that such models may be made at any time with few tools and materials enables the young collector to collect rare fruits that he finds on his travels or that he may now and then run across in the fruit markets. Few people have any idea of the immense number of tropical fruits, or the appearance of even the commoner varieties, such as mangoes, sour-sops, kolas, vanilla beans, custard apples, etc., but the boy who goes to the tropics for the winter can obtain exact counterfeits of all these and many more, and on his return show his friends exactly how they looked.

Prize fruits and vegetables exhibited in fairs and shows may be reproduced by wax casts, and quite often the owners will be glad to pay a reasonable price for such models, and the money thus obtained may be used to excellent advantage in purchasing additional specimens or supplies for the museum. Moreover, making casts of fruits is far simpler than making casts of animals, and by practising on fruit you can obtain a lot of experience which will help you greatly when you attempt to cast the frogs, fish, and reptiles, and in the mean time you will obtain an attractive and interesting series of wax fruits.

Chapter XXXVII

THE WOOD AND TREE COLLECTION

A GOOD collection of native woods is a most valuable and important item in a museum, and there are few first-class museums that do not possess a more or less complete collection of our native timber trees.

Whether the collection is valuable and instructive or almost worthless and far from presenting an attractive appearance depends largely upon the care with which the specimens are collected and prepared and the proper labeling and exhibition of the different specimens.

Few of us stop to realize the number of varieties of native woods growing in our own neighboring forests, and fewer still are able to recognize many of our commonest woods when we see them. Not many of us even know the differences between the various tree-barks or how the grains run in the natural trunk, while many do not even know the leaves of the common trees by sight, and even when we know the tree in summer we fail to identify it when bare and leafless in winter.

Native timber is daily becoming scarcer, and many kinds of wood are now almost unknown in districts where a few years ago vast forests existed.

Many of the common, every-day woods are very handsome when properly cut and polished, and among the woods found in almost any locality may be found hard and soft woods, dark and light woods, flexible and brittle woods, and, in fact, woods suitable for nearly every purpose. Some of these are already widely used, while others have been neglected or their desirable qualities and peculiarities undiscovered.

For many years the southern cypress was a wood despised and considered as worthless, and thousands, if not millions, of feet of cypress lumber were destroyed and burned merely to get rid of it when clearing land.

To-day cypress is a wood highly prized and widely used for numerous purposes, and is immensely valuable.

The southern gumwood, which was formerly considered even more worthless than the cypress, now yields immense revenues to the manufacturers of butter dishes, peach baskets, fruit crates, and all sorts of domestic and commercial receptacles. Its tough, fibrous, flexible wood particularly fits it for these purposes, and huge logs of gum are placed in machines that pare off thin sheets of wood which can be bent, folded, and worked into shape almost as readily as pasteboard or sheet metal.

A study of these woods and a series of prepared specimens to illustrate their superior character for certain uses would undoubtedly have brought them to the notice of lumber-dealers long before their value was finally discovered, and these are but two examples of their kind. No doubt many other woods are just as well adapted to special purposes and are not used, merely because their properties and qualities are not commonly known.

[redacted]

THE WOOD AND TREE COLLECTION

Wood collections are among the easiest of all collections to make, and during the winter, when other things are hard to collect, the woods may be gathered, prepared, and classified, and the collection will be well advanced before spring arrives.

Collecting specimens for this exhibit should not be confined entirely to the cold months, however, for a well-arranged wood collection must show not only the barks and timber, but leaves, fruit, flowers, and seeds as well.

A very important portion of the wood collection is a series of photographs showing the general appearance of the trees, and as these should show the trees in both winter and summer (except in the case of evergreens) you will have to work more or less on this collection at all seasons.

Before collecting woods in winter you should be absolutely sure that you know the species of tree from which each specimen is obtained. If in doubt about it look for old dead leaves clinging to the branches, for fallen leaves may be blown for long distances, and are not nearly as certain a means of identification as leaves still attached to the twigs. If these cannot be found, search under the tree for nuts or fruit, and if these agree with the leaves lying about you may be pretty certain of the species of the tree. If, after using due care, you are still doubtful of the tree's identity, ask some lumberman or farmer, and if they do not know wait until the leaves and flowers come out in the spring.

Although the best and most perfect specimens are obtained from living trees, old woodpiles often contain splendid specimens, and, as a rule, the farmer or woodsman who

cut the trees knows what they are and can tell you the names of any you do not know and can point out other growing trees of the same kind that you may wish to photograph.

You will not require many tools or implements for collecting your wood specimens; a saw, a hatchet or small ax, a sack for carrying them, and a carpenter's pencil are the only things required, and the preparation of the specimens will require no tools other than the common carpenter's tools that you should always have on hand.

Of course, if you take photographs of the trees you will need a camera, and for this purpose, as in all nature photography, you should have a good, fairly long-focus bellows camera with a tripod and ground-glass back. Ordinary kodaks or snap-shot cameras will not answer, and poor photographs are no better than none at all. Photographs, while very valuable in connection with the wood collection, are not absolutely essential, and the collection will prove very interesting and instructive without them.

Chapter XXXVIII

COLLECTING AND PREPARING THE WOODS

THE wood specimens should all be of nearly the same size; and as pieces too small or too large will either show too little of the characteristics of the species or will occupy more space than necessary, a medium size is preferable. By selecting straight, well-grown limbs about three or four inches in diameter a good average will be obtained, although you will at times be obliged to take smaller specimens from some trees, or pieces split from the main trunk or large limbs in others.

Cut the limb off carefully, leaving the bark in place and taking a piece about a foot in length. As soon as the piece is cut it should be numbered and marked with the name, date, and locality. This is best done by chopping or whittling off a little of the bark at one end and writing directly on the wood with the carpenter's pencil (Fig. 1). The pieces of wood thus collected should be placed in a cool, dry place to season, and should be turned over occasionally to dry them evenly. If the bark shows a tendency to peel or split off from the wood you should wrap a piece of string around it.

When the wood is thoroughly dry, saw off one end diagon-

ally with a fine-tooth saw at an angle of about forty-five degrees. A miter-box should be used if possible, as this will insure all the pieces being cut at the same angle, and will add greatly to the neat and orderly appearance of the collection.

Next, with a draw-knife and plane work down the side, on the short side of the angle, until the exact center of the piece is reached. Your specimen will now be a half-round piece of wood with one end sawed off at an angle and the natural bark on the rounded side. Now smooth off a little of the bark and outer wood on the right-hand side (facing the flat side with angle end up), to show the grain, and finally cut the piece off squarely and smoothly about eight inches from the sloping end. The piece will now appear as illustrated in Fig. 2; in which the dotted lines show the parts of the wood that have been cut away.

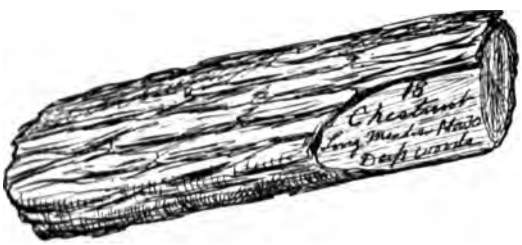

Fig. 1

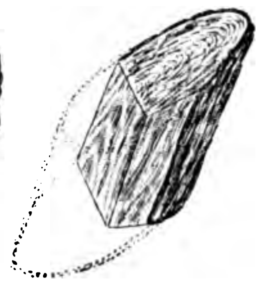

Fig. 2

When the piece has been cut in this way a small portion, about two inches, from the base, or square end, should be marked off with a light pencil mark, and this space should be given a coat of good varnish. The angle, side cut, and

[redacted]

edge cut should be planed, sandpapered, and smoothed until no roughnesses or irregularities remain; and your specimen will now show the bark, a cross-section, a heart section, and a quartered section of the wood in its natural color, as well as a heart and quartered section as it appears when varnished.

In mounting these wood specimens set each one upon the square end and slightly turned to show all the various sections. Cardboard mounts can be easily tacked to the wood by a tack driven up through the bottom, and quite a wide space of card should be left on the front and right-hand sides of the wood. On this space the fruit and leaf of the species shown will be mounted, and if photographs are used in connection with the collection they may be placed on the wall behind the wood and its mount, or may be hung on the edge of the shelf below it.

The fruits or nuts of most trees are very easy to preserve, and merely require drying, but many of them will continue to ripen after being collected or will crack or burst when dried, and to prevent this they should be boiled a few minutes in water or soaked in strong alcohol or formaline solution before drying. Where nuts are borne in peculiar pods or burrs, as walnuts and chestnuts, the whole pod with nuts inside should be preserved as well as one of the nuts removed from the pod or burr.

If the tree bears berries or fruit that shrivel up when dried, you will have to prepare wax models as directed in the previous chapter on fruit collections.

Leaves, as a rule, are easily prepared by merely pressing them between paper or blotters, as already described, but some kinds have a tendency to curl up even after being

thoroughly dried. Wherever the leaves are palmate, or are composed of numerous leaflets attached to a single stem, you will find that the leaflets will often drop off after drying. These may be glued in place again, and the whole leaf preserved by attaching it to the cardboard mount. Leaves that curl up or are very fragile are hopeless, however, and in such cases the real leaves may be replaced by solar prints or autograms of the leaves. The solar prints are easily made with either blue-print or printing-out paper, and the only materials required for the former are a printing-frame, a glass for the frame, and the prepared blue-print paper.

Place the leaf to be printed face-up on the glass, lay the paper face-down upon it, close the frame and expose to direct sunshine until the paper around the leaf has become deep bluish or greenish gray—the darker the better.

Remove the paper and wash thoroughly in cold water, and a beautiful print of the leaf, showing white on a deep blue background, will result.

If your printing has been carried far enough, each tiny vein and rib will show in delicate blue lines, and the print has the great advantage over the real leaf of never breaking, curling, or decaying, and will be free from insect pests that destroy dried leaves.

Prints of leaves on printing-out paper, like solio, etc., are made in exactly the same way as far as printing is concerned, but these must be toned and fixed with chemicals like a regular photographic print. These solar leaf-prints on photographic paper are very beautiful and show every minute detail of the real leaf; in fact, they show even more than the original, and in some ways resemble patterns in lace (Fig.

3). Even flowers, grasses, and plants with leaves and flowers may be made in the same way, but subjects with very thick or fleshy stems, leaves, or flowers do not make good subjects, as prints made from them will not have clear, sharp outlines, owing to the light striking the paper beneath the

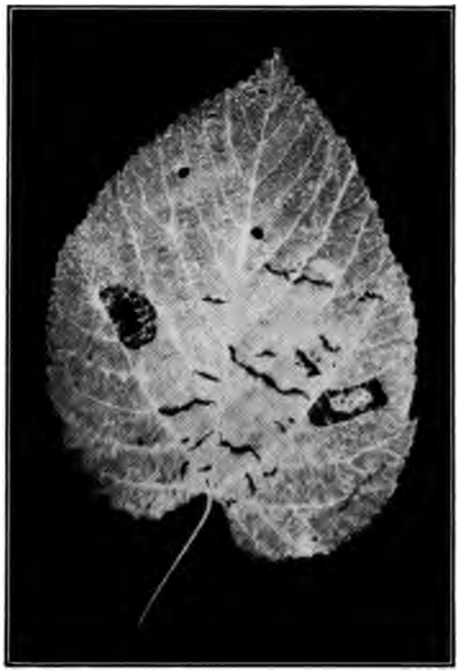

Fig. 3

edges of the specimen, and thus producing a soft, shaded edge and giving it the appearance of being out of focus.

For those who cannot avail themselves of either of the above processes the autogram method of making prints is

excellent, and in some ways these are even superior to solar prints.

Autograms require no special materials; a rubber roller, such as is used in mounting photographs, a little printer's ink or some tube oil-colors, and some stiff white paper are all the materials required.

Place a fresh leaf on a sheet of paper or card and brush the under surface smoothly and evenly with a coating of the printer's ink or paint. Do not get on too much, but use only enough so that every part of the leaf is coated evenly. Place the inked surface of the leaf on a piece of the clean white paper, cover it with a piece of soft paper, hold the stem in place with one finger pressed upon it over the cover-paper, and run the rubber roller firmly over the whole.

Now lift off the cover-paper and the leaf, and you will find that a perfect and beautiful impression of the leaf has been printed upon the paper beneath, exactly as if the leaf were an engraving or type. If you have a letter-copying press in the house you may obtain even better prints by its use for this method. Care should be taken that the paper on which the print is to be made rests upon a level, rather soft surface, such as a pile of old newspapers or a thick magazine, and be very careful not to smudge the print when placing or removing the leaf.

These autogram prints may be made in any color, and when produced in deep green they very closely resemble real leaves mounted on white paper. Even dead and partly dried leaves may be thus reproduced and excellent impressions obtained.

Still another method of procuring facsimiles of leaves

to exhibit with your wood specimens is to arrange the fresh leaves on a piece of clear glass, supported at some distance above a white background, and then photograph them.

In order to do this the camera must be placed vertically and the objects horizontally; but nearly as good results may be obtained by placing the leaves in a printing-frame with a glass cover, placing a piece of white paper or card behind them, and then photographing the whole. The only objection to the latter method is the difficulty of preventing the reflection in the glass from showing, and the fact that thick leaves, or leaves with thick stems, will often throw quite a shadow which will confuse the outline. Photographs of leaves made in either of these ways will show every detail of the leaf, and will answer exactly as well for exhibition purposes as the real leaves.

Many species of trees have leaves of two or more distinct forms, and in some cases, as in the mulberry and sassafras, the two shapes may be so very different that you would never suspect that they belonged to the same tree. Where such a variation in the shape of leaves occurs regularly and naturally you should show typical examples of each form.

When your wood, with the fruit or seed and leaf, or print of the leaf, are ready they should be mounted on the cardboard together, the wood near the center, with the fruit and leaf at either side, or, if preferred, both the leaf and seed may be mounted on the same side of the wood. The card should then be labeled with the name, locality, and kind of country in which it was found, and the height, diameter, and circumference of the tree noted. If the wood has any

special properties these should also be added. The general form of these labels should be somewhat as follows:

No................**Locality**..................
Name..
Found in..................................
Height........**Diam**........**Circum**..........
Qualities of Timber..........................
Used for..................................

These labels may be fastened either to the card or on the wood itself, but, as they apply to the wood, leaves, and seeds

Fig. 4

together, it is advisable to place them on the card near the forward edge (Fig. 4).

The photographs of trees, if you decide to have them, should be large enough to show the trees to good advantage, and should be printed on some permanent mat-surfaced

paper such as platinum or velox. In selecting the trees for photographs try to find the most symmetrical and typical examples of their kind, for scraggy, one-sided, or broken-down trees, or trees that have been artificially pruned or trimmed are of little value for your collection.

Endeavor to select trees that are more or less isolated, and that stand in the open, and that do not have ugly fences, buildings, or thick brush around them. By choosing well-shaped trees and arranging the camera so that some attractive object in the foreground or background is shown very artistic pictures may be obtained. At times buildings or other surroundings add a great deal to the picture, and whether or not such accessories are included is a matter that must be left to the judgment of the photographer.

One photograph should be taken late in the fall or early in the spring, when the tree is bare and leafless, and, if necessary, this picture may be secured in midwinter. If snow is on the ground you had better wait until the earth is bare, however, for pictures of trees with snow-covered earth usually show too much contrast.

The second photograph should be made from the same spot as the first, but should be obtained after the tree is in full leaf. The best time to take this picture is late in the spring, when the leaves are fully developed, but are still fresh and tender green.

Evergreen trees require but one photograph, as their appearance does not alter with the seasons, but to bring them out to better advantage they should be taken in late fall, early spring, or in winter, when other trees are leafless. By doing this the evergreens will show up well, even if in

quite thick woods or with numerous deciduous trees around them.

Some kinds of trees are very typical in form or mode of growth, as the Lombardy poplars, weeping willows, tupelos, and others, but many kinds have two or more typical forms. Thus the common elm sometimes grows in a beautiful vase-shaped form, at other times in a fan shape, and at other times with pendent "weeping" branches. In such cases you should either show all the typical forms or should use the photographs of the same form from which your specimens were obtained.

Finally, I would advise every boy, whether he collects specimens or not, to study the trees in his vicinity. Learn to know each tree by form in either summer or winter, note how the branches grow from the trunk, the character of the bark, the shape of leaves, the form of flowers and seeds; and sooner or later you will find the knowledge of value, and that each kind of tree has its own characters, and that certain points are always constant and will enable you to recognize the tree at a glance at any season of the year.

All this will train your eyes and teach you to observe things closely, and you will appreciate the woods and forests far more than you ever did before, and you will no longer pass by the trees as uninteresting and inanimate objects, but instead will grow to know them as friends and living things, each with its own peculiar features, form, and individuality.

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Chapter XXXIX

LACE AND BOATS THAT GROW ON TREES

HOW would American girls like to pick their cloth and lace ready-made from trees, I wonder? This sounds very funny, does it not, and yet the Indian girls in some parts of South America really can do this, and the cloths that grow in this queer way are very delicate and beautiful besides.

This tree cloth or lace is known to the South Americans as "*seda virgen,*" or virgin silk, and it is really the tough, fibrous pith of forest trees. In order to procure this beautiful material it is only necessary to break open a branch of the lace tree, pull out the pith, and unroll it into sheets. Often these sheets of delicate fiber are over a yard square, and they are used by the South American girls and ladies as veils, handkerchiefs, mosquito-netting, portières, sheetings, etc. Although very delicate and pretty, yet the lace is extremely strong, and is often made into harness, ropes, hammocks, and even suspension bridges across the mountain streams.

It is so abundant that it is seldom washed, for it is far easier to cut some new lace from a near-by tree than to wash that which is soiled.

When first cut it is tinted a delicate cream color, but

bleaches to a snowy whiteness, and is one of the most beautiful products of nature. The first photograph shows a branch of the lace tree with a portion of the lace pith unrolled. In this form it is often used as a whisk-broom.

The second photograph shows a portion of a sheet of the lace spread out and bleached, and you can see what delicate and lovely lace this strange tree produces ready for use.

Fig. 1

Fig. 2

Strange as it may seem to have lace and cloth grown on trees, it is even more peculiar to think of boats growing on trees, and yet this really occurs in the West Indies. The illustration shows one of these natural-grown boats, which the little West Indian and Carib boys are very fond of sailing, and the regattas and races of these tiny craft are just as pretty and exciting as the model yacht races held by northern boys on the park lakes and ponds.

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When a West Indian boy wants a toy boat all he has to do is to visit a cocoanut tree. These trees bear great bunches of nuts among their drooping green leaves, and when the bunches first sprout out in the form of a big bud it is inclosed within a hard, tough, woody case, or spathe, two or three feet long, eight or ten inches in diameter, and tapering to a point at one end, and to a slender stern at the other; in fact, it looks very much like a huge wooden cigar.

As the buds and flowers develop the spathe splits open and the flower-bunch continues to grow out beyond it until the nuts begin to ripen. By this time the spathes have become dry and hard and break off and drop to the ground of their own accord.

It is these spathes, or bud-coverings, that the West Indian boys use for toy boats; and, while the dry and fallen ones will answer, better boats are made from the flexible and partly green spathes still clinging to the flower stem.

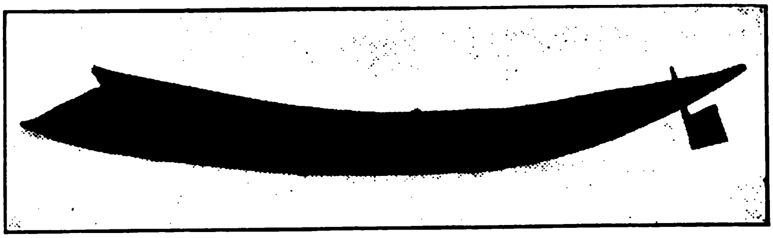

Fig. 3

The spathe, as gathered from the tree, is almost in the shape of a boat, and all that is necessary to transform it to a very seaworthy and fast sailing toy canoe is to sew

the open end together, and fit rudder, sail, and seats, or thwarts.

When this is done the boat is almost an exact model of the big dugout canoes that the boys' fathers use in fishing. In fact, these dugouts were probably copied from one of the tree-grown boats (Fig. 3).

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Part X

MISCELLANEOUS COLLECTIONS

Chapter XL

CURIOS AND UNCLASSIFIED SPECIMENS

NO matter how carefully you may have tried to classify and arrange your collections, you will find that there are a lot of things that do not really seem to belong in any particular group or collection. A great many of these will be objects given to you by friends or neighbors, and you should always accept everything offered out of courtesy and to keep up and encourage an interest in your museum. Many of these things are really quite worthless, but, nevertheless, if they are not exhibited the donors will feel hurt, and next time when they have something that is really worth while they may not offer it.

Some things must be destroyed, for oftentimes gifts of birds, insects, or other objects are so filled with insect pests that to place them in the collections with other specimens would result in untold damage. The only thing that can be done with such nuisances is to cremate them in the nearest fire or soak them in benzine and place them in a box or case by themselves; if they are really rare or peculiar this is the best method.

Most specimens can be classified if proper care is taken

and you are not misled by general appearances, but a great many things are best separated from the other collections and placed in a case or on shelves devoted to curios, freaks, and unclassified collections.

Many so-called curios are in reality very ordinary things; thus the odd-shaped root of the wild mandrake (Fig. 1) is often considered a curio with supernatural powers attributed to it by the ignorant. This should, of course, be placed in the botanical collection, as well as any other odd forms of vegetable life. Galls, formed by a species of insect, on leaves and on twigs and flowers properly belong in the insect collections, and may be exhibited with the gall-insects themselves.

The sea-horse is another example of this class of specimens, for this odd creature is really a true fish, but, owing to its peculiar form and its resemblance to a horse in the shape of its head, many young naturalists are at a loss to locate it in its proper place in the animal kingdom.

Sometimes travelers from distant countries, or soldier or sailor friends, may give you some souvenir or curio picked up in their wanderings; and, as such things have a real value in illustrating the customs and habits of distant races or the peculiar industries or products of foreign lands, they should be exhibited in a case by themselves as curios even if they are really of vegetable or animal origin. The bark-cloth from the interior of Brazil might belong quite properly in the botanical section, but it is not strictly a botanical specimen, and is far more interesting as an exhibit to show the native products of the district from which it was obtained. Other specimens which will serve the same purpose

may verge so closely on the line of strict curios that it is hard to distinguish between the two classes, and hence it is easier and better to place all such things in a section labeled

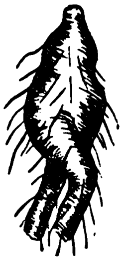

Fig. 1

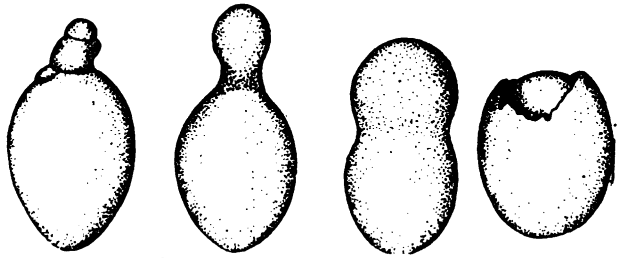

Fig. 2

Fig. 3

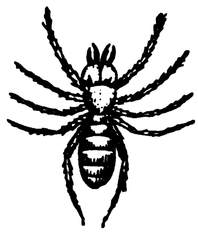

Fig. 5

"Curios and Unclassified Collections." In this section you should place such objects as the bark-cloth, the queer monkey-beans, which are partly natural and partly artificial, carved cocoanuts, decorated whales' teeth, and, in fact, any specimen that is curious and at the same time is of any real scientific or educational value or interest. In this same section you should also place all freaks and malformations or abnormal forms similar to the turtle, frog, coral, etc., mentioned in the first chapter, and other specimens of a similar nature, such as the freak hens' eggs (Fig. 2),

the saw-fish and swordfish snouts borne originally by large salt-water fish, and all other natural curios. Do not, however, include anything in the nature of mere souvenirs, such as chips and pieces of monuments, buildings, and other structures, or coins, stamps, and autographs, unless you want to turn your natural-history museum into a dime museum or side-show.

Certain creatures that you will obtain in your collectings

Fig. 4

will be very hard to classify, for they do not properly belong in any of the various collections described. Among these are centipedes (Fig. 3), scorpions (Fig. 4), and jointed

spiders (Fig. 5), besides the common spiders and daddy-long-legs that we all know so well.

As a matter of fact, scientists and naturalists do not yet know exactly where to place these curious creatures. The spiders and scorpions are in many respects much like true crustaceans, and, as a rule, they are placed between the crustaceans and insects in a special group known as arachnids. The centipedes and millipedes are no doubt related to the insects, but they differ so greatly from any other creatures that they are usually placed in a separate group, known as the myriopoda. As the spiders and scorpions merge into one another through the various forms known as whip-scorpions, pseudo scorpions, and similar things, and the millipedes and centipedes vary in structure and form, the student becomes confused and discouraged in trying to discover just where to place these aberrant creatures. It is a good plan not to bother over this matter at all, but to place all your specimens of spiders, centipedes, and other intermediate or special groups in a department by themselves among the "Curios and Unclassified," for most of them *are* practically unclassified, in fact, and *all* of them are curios.

Chapter XLI

SOME SPIDERS AND THEIR ODD WAYS

IF you stroll through the woods some cool autumn morning you will notice many a spider's web stretched between twigs or grasses and hung with dewdrops that glisten like silver in the sunshine. If you are at all observant you will notice that the webs are of various shapes and patterns. Some are placed in the grass and are woven closely in a sort of silken carpet, or mat, with a little funnel-shaped opening at one side. Others are loose and flimsy, strung hit-or-miss, it seems, while others are beautiful, wheel-shaped affairs with straight spokes radiating from the center and with numerous spirals stretching from spoke to spoke. Each of the various kinds of webs is made by a certain species of spider, and each serves its special purpose in enabling the owner to trap the sort of insect upon which the spider feeds.

The carpetlike webs are made by quick, brown, hairy spiders that lie in wait beneath the shelter of a near-by leaf, or within the funnel-shaped holes, and dart out and seize any insect so unfortunate as to drop into the silvery carpet. As these nests are almost always built close to the ground, we would expect that most of the insects caught would be ground-

loving species such as grasshoppers, crickets, beetles, etc., and a close examination of the nets will prove that this is the case, for one can almost always find the remains of numerous captured insects either in or near the little trappers' homes. Quite a different and far more interesting affair is the beautiful net of the orb-weavers or geometrical spiders—the wheel-like webs stretched between twigs and bushes.

To build these nets requires time and skill, and the process of weaving them is one of the most interesting things in insect-land.

In the first place, we must understand how the spider produces the silk from which the web is made. If you will look closely upon the lower side of a spider's body you will see a little group of tubelike organs, usually six in number. These are the spinnarets, special organs for forming the dainty silken strands (Fig. 1). Opening from the end of each spinnaret are a large number (often as many as two hundred) of fine tubes. Within the spider's body the thread is formed in a liquid state, and when forced through these tubes and meeting the air it hardens, and the numerous tiny threads combine to form a single strand. When the spider wishes a fine thread he places the spinnarets close together, while, if he requires a broad band or is in a hurry to secure some insect tangled in the web, he spreads his spinnarets far apart, thus forming a delicate silken ribbon.

Not only can he regulate the size of the thread, but many species can produce elastic, sticky silk or dry, inelastic silk at will. These two kinds of thread are used for very different purposes, although both are often used in making a

single web. The dry threads are always used when the spider wishes to drop from place to place, for making silken bridges from twig to twig, and for stays and framework to the web; while the sticky threads are those which catch the spider's prey, their elasticity preventing the captive's struggles from breaking them, and at the same time serving to entangle him the more.

When the orb-weaver wishes to build one of the handsome webs he first spins several lines extending irregularly from one twig to another where he wishes the finished web to spread. These serve as a staging on which the builder can run back and forth while stretching the other strands of the web. After the staging is done our busy friend fastens a thread to some twig, or to one of the staging lines, and walks along spinning as he goes, meanwhile with one hind foot carefully holding the new thread from becoming tangled with the object over which he travels. This new thread he carries around the staging until it crosses the point which will be the center of the completed web. Then he pulls in the slack, and, fastening the line securely, runs nimbly back to the center of the web. Here he starts another thread and, spinning and guiding as he goes, walks back to the outer framework and secures it a short distance from the first thread. This operation is repeated until all the radiating, spoke-like lines are spun and in place. Now the little worker goes to the point where these spokes cross and, fastening a thread, walks round and round in an ever-widening spiral, sticking the new thread to each spoke as he crosses it. In this way he forms a web that looks like a coiled spring, each turn of which is as far from the next as

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Fig. 1

1—Spinnarets of spider.
2—Spinnaret tubes enlarged.

Fig. 2

Opening of trap-door spider's nest.

Fig. 3

The spider aeronaut.

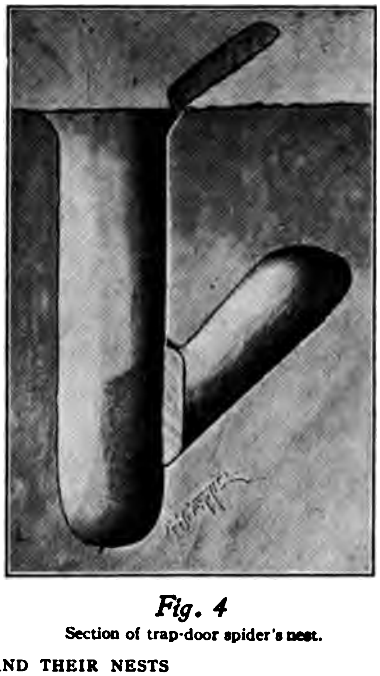

Fig. 4

Section of trap-door spider's nest.

SOME SPIDERS AND THEIR NESTS

the spider can reach. Now the tiny architect has the most important part of his work to do, for so far he has merely made a frame, or support, of dry, inelastic thread. Commencing at the outer end of the spiral, he fastens a sticky, elastic thread, and, traveling backward around his web, forms a second spiral, the turns of which are close together. As he passes along with this second thread he destroys the first, or dry, spiral, leaving little fragments hanging here and there to the radial spokes. At last the center of the web is reached, the beautiful geometrical web is completed, and, hiding among near-by leaves or hanging head downward from the center of the web, the maker awaits his prey. As he hangs there he grasps several of the spokes with his feet, and instantly detects the slightest jar caused by an insect fouling the web.

Related to these orb-weavers, which are usually large-bodied, brightly colored fellows, is a little round-bodied chap who spins a web far more wonderful than that of his big cousins. The nets can usually be found among twigs and branches of evergreen trees, and at first sight appear simple and uninteresting affairs. They are triangular in shape, composed of four radiating lines crossed by a number of coarse, double threads, and fastened to some convenient twig by a stout thread extending from the apex of the triangle. But if you watch the net patiently, or touch it gently with a twig or bit of grass, you will be greatly surprised to see the whole web dart suddenly forward and wrap itself around the object—exactly like a bolas or lasso. In fact, the owner of this simple-looking web is really an expert lasso-thrower, and seldom or never misses his mark

(Fig. 5). Examine the supporting line carefully, and you will find the owner snugly hidden where it joins its supports, his hind legs holding firmly to the line and his forward legs grasping some loosely coiled slack, but pulling the four spreading lines and their connecting bars taut. Here he sits patiently, but ever on the alert, until some buzzing fly or blood-thirsty mosquito comes along and bumps into the web. Instantly the spider lets go with his fore feet, and the

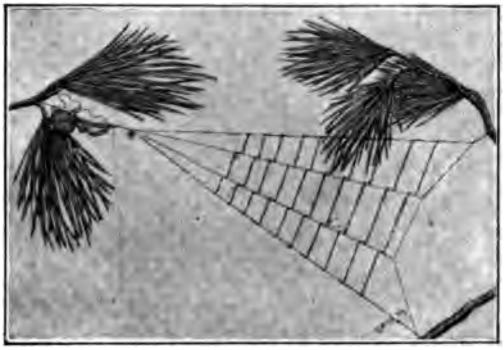

Fig. 5
Lasso-throwing spider.

Fig. 6
Bird-eating spider.

elastic web springs forward, entangling the unfortunate intruder. Then the spider draws the web tight and again snaps it forward, repeating the operation again and again until the victim is thoroughly secured and the ingenious little assassin can suck its blood at leisure.

Wonderful as is this cleverly constructed trap, more remarkable yet is the fact that many of our common spiders use their thread for balloons, and by their aid travel through the air for long distances, sometimes hundreds of miles.

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When the little aeronaut wishes to make an ascension, he climbs to the highest spot he can find, such as a fence-post, low bush, or the tip of a blade of grass, and here, holding by his fore feet, he stretches his body upward and rapidly spins out a thread. The free end of this line is carried up and away by the breeze and rising warm air, until at last, enough having been spun to lift the spider's weight, he lets go his hold and sails gaily away (Fig. 3).

Perhaps you think this simple, breeze-borne thread should not be dignified by the name of "balloon," but nevertheless the little spider can regulate his speed and sail in safety far more successfully than did even the famous Wright brothers. If the breeze freshens he has only to gather in some loose silk, while if it grows calm and he falls earthward he can spin out yard after yard of floating gossamer. These flying-spiders are very common, for the habit is almost general among many species of young spiders, and on warm autumn days we may often see hundreds of their threads streaming upward from fences, grass, and bushes or floating about in the air. Borne on the wings of a stiff September wind, these tiny adventurers travel far and swiftly, and have even been seen floating safely through the air far out to sea.

Many American boy readers who live in our Western states know the famous trap-door spiders and their cleverly built nests formed by lining a burrow in the earth with a coating of thick silk and fitting a tightly closing door to the whole. (Fig. 2 shows the opening of a trap-door spider's nest.) Although the common Western trap-door spider's nest is so well made and so unusual as invariably to excite interest in the beholder, yet some other species of the genus

[redacted]

show a foresight and cleverness in constructing their homes which is almost beyond belief. These fellows are not content with a single trap-door to their homes, but for greater safety dig one or more side tunnels, also provided with trap-doors opening into the main burrow. These underground nests serve as a resting-place for their owners, as well as a safe retreat into which they may dart when pursued by an enemy. If their pursuer succeeds in opening the first door the spider backs into one of the side chambers, shuts the door behind him, and leaves the pursuer baffled at the apparently empty nest. Sometimes, too, if he thinks himself in danger, he digs his way to the surface some distance off and scuttles away while his enemy is still poking about in the deserted home. (Fig. 4 shows a section of trap-door spider's nest with side chamber.)

Although these trap-door spiders and their nests are considered as curiosities in the East, the Eastern boys need not despair, for we really have trap-door spiders in the Eastern states which make silk-lined burrows in exactly the same manner as their Western cousins. These spiders belong to the genus *Lycosa*, and look much like small tarantulas, with the exception of their jaws, which move sideways instead of up and down. The lycosas dig their holes in open sandy spots and usually conceal their home by covering the door with bits of grass, twigs, or small pebbles, while one species even builds a little watch-tower of straws and twigs above the entrance to his subterranean home.

Closely related to the trap-door spiders are the true tarantulas, and there are few spiders which have been written and talked about as much as these; but, although

so big and ugly, they are not by any means as large or formidable as their bird-eating cousins, the mygales of Central and South America (Fig. 6). Neither these nor the tarantulas are really as dangerous as most persons believe, however, for, while their large and sharp jaws can inflict deep and painful wounds, it is seldom that serious results follow the bites, and I doubt if they ever prove fatal to human beings. I have been bitten several times by the giant mygales and never found the wound half as bad as the sting of a common yellow-jacket. Whereas the mygales and tarantulas capture their prey by springing upon it from ambush and are capable of killing good-sized birds and animals, the great silk-spider of Bermuda spins webs so stout and strong that sparrows and other small birds are often caught in them and are devoured by the owners. One can scarcely imagine a more gruesome or horrible fate than to be entangled hopelessly in a giant spider's web while the great hairy monster rushes to devour his prey. How fortunate for us that spiders are not as large as bears or wolves, with webs capable of enmeshing men as easily as the little woodland species capture their insect prey.

Appendix I

GLOSSARIES OF SCIENTIFIC TERMS

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I

GENERAL GLOSSARY

AS a great many terms used in speaking of the various divisions, groups, families, and species are unfamiliar, and as no common English equivalents are in use, the accompanying glossary has been prepared in order that the young naturalist entirely new to the field may obtain some idea of just what these terms and names really mean.

In looking up specimens in books it will often be found that the descriptions, although otherwise plain, contain numerous names for the parts of the animal and the colors that are unfamiliar to persons not trained in scientific work.

These technically scientific words are particularly common among the marine invertebrates, for these creatures are so numerous in both species and individuals that it is next to impossible to coin English names or terms to suit them all.

While this glossary is by no means complete, it will be found to contain most of the words commonly encountered by the amateur naturalist, and will, it is hoped, prove sufficiently complete for its purpose.

Abdomen	Belly.
Abdominal	Anything pertaining to or associated with the belly.

Abortive	**Remaining or becoming imperfect or undeveloped.**
Acuminate	**Tapering to a gradual point.**
Acute	**Sharply pointed.**
Adipose	**Fatty.**
Adipose fin	**A peculiar fleshy projection on the backs of certain fish, such as salmon, catfish, etc.**
Adipose tissue	**Fat.**
Air-bladder	**A sack filled with air found in fish and corresponding to the lungs of other creatures.**
Altrices	**Birds that are reared and fed in the nest by their parents.**

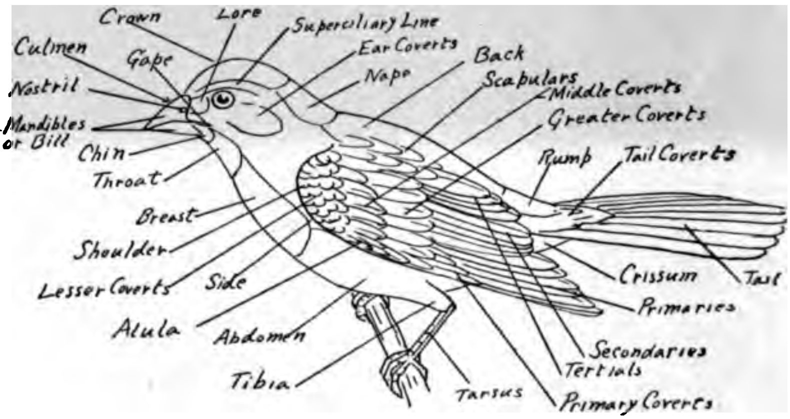

Fig. 1

PARTS OF A BIRD

Alula	The feathers attached to the "thumb" or outer joint of a bird's wing.
Alveoli	The tooth sockets.
Alveolar surface	A part of a turtle's jaw where the tooth sockets would be in other animals.
Anadromous	Marine fishes that swim up fresh-water to lay their eggs.
Anal fin	The last fin in the median line in front of the tail and behind the vent.
Anal plate	The large scale or plate in front of the vent in snakes.

GLOSSARIES OF SCIENTIFIC TERMS

Anteorbital plate	The plate or scale in front of a snake's eye.
Antrorse	Turned forward.
Anus	The external opening of the intestine; the vent.
Articulate	Jointed, so as to be movable.
Artiodactylus	Even-toed (toes 2 or 4).
Attenuate	Long and slender, as if drawn out.
Auricle	The large lobe of the external ear; also one portion of the heart.
Barbel	Long fleshy projections on some fishes, such as the "horns" on catfish and bullheads.
Basal	At or near the base.
Bicolor	In two colors.
Booted	A form of bird's legs where the scales form a continuous surface without visible edges along the front.
Branchiæ	Gills.
Branchial	Anything to do with gills.
Caducous	Falling off early.
Calcareous	Composed of or containing carbonate of lime.
Canine	Doglike.
Canine teeth	The eye-teeth; any front teeth longer than the others in fishes.
Carapace	The upper shell of a turtle.
Carinate	Having a ridge or keel along the center.
Carpus	The wrist.
Caudal	Anything to do with the tail.
Caudal fin	The tail of fishes.
Cere	The fleshy or skinlike covering of the base of a bird's bill, as in hawks, owls, etc.
Cervical	Relating to the neck.
Cervical vertebræ	The vertebræ where the neck joins the skull.
Chin	The space between the two bones of the lower jaw.
Ciliated	Edged with hairlike organs.
Cinereous	Ashy-colored.
Clavicle	The collar-bone.
Cœcal	Of the form of a closed sack.
Cœcam	An appendage like a closed sack connected with the intestine.
Commissure	The line on which the mandibles of a bird are closed.
Compressed	Flattened sideways.
Condyle	The surface of a bone where it joins another to form a joint.

Conirostral	A conical-shaped bill of a bird.
Costal	Relating to ribs.
Costal folds	Folds of the skin in salamanders which show the position of the ribs beneath.
Crissum	The under feathers at the base of the tail of birds.
Ctenoid	Rough-edged, especially the margins of scales.
Culmen	The central line, or ridge, of the upper part of birds' beaks.
Cuneate	In the form of a wedge; said of a bird's tail that has the middle feathers longest, and the rest gradually decreasing in length toward either side.
Cycloid	Smooth-edged.
Deciduous	Temporary; falling off at times; trees that shed their leaves.
Decurved	Bent down.
Dentate	Having toothlike notches.
Dentorostral	Having a notch near the tip.
Depressed	Flattened up and down.
Dermal	Relating to skin.
Diaphanous	Translucent, or nearly transparent.
Digital	Relating to toes.
Digitate	Toed.
Digitigrade	Walking on the toes, like dogs.
Dorsal	Relating to, or connected with, the back.
Emarginate	Slightly forked or notched at the tip; also applied to feathers that are abruptly narrower near the tips.
Endoskeleton	The true skeleton.
Epignathous	Having the bill hooked.
Erectile	Capable of being raised.
Exoskeleton	Hard, bony parts on the outside of body.
Exserted	Projecting outward.
Facial	Relating to the face.
Falcate	Sword or scythe shaped, long, narrow, and curved.
Falciform	Curved like a sword or scythe.
Fasciated	Banded.
Fauna	The living things (exclusive of plants) that inhabit one district or region.
Ferruginous	Rust-colored.
Fibula	The small, outer leg-bone.
Filament	Any threadlike structure.

Filamentous	Like a filament.
Filiform	In the form of a thread.
Fissirostral	Having the bill very deeply cut behind the hard portion, as in whippoorwills, swallows, etc.
Foramen	A hole or opening.
Forficate	Deeply notched or forked.
Fossæ	The grooves in which the nostrils are placed, as in birds.
Fossorial	Adapted for digging.
Fulcra	Small spinelike scales on the fins of some fishes.

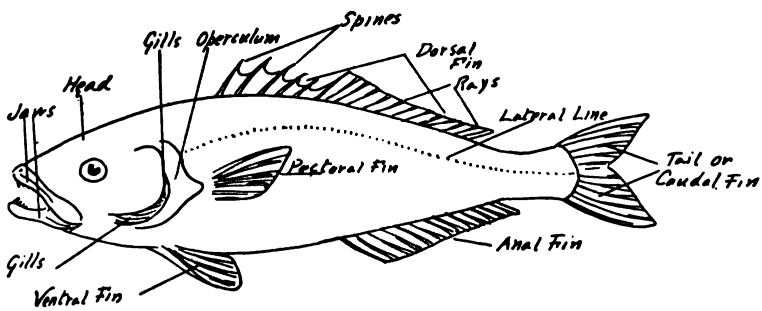

Fig. 2

PARTS OF A FISH

Fuliginous	Smoke-colored or sooty-brown.
Furcate	Forked.
Fuscous	Dark brown.
Fusiform	Spindle-shaped; tapering toward both ends.
Ganoid	Scales or plates of bone covered with enamel.
Gape	The opening of the mouth.
Gastrosteges	The broad, bandlike scales along the under side of snakes.
Gills	Organs for breathing the air contained in water.
Gill openings	Openings leading to the gills.
Gill-rakers	Comblike teeth in the mouth of some fishes.
Glabrous	Smooth.
Glaucous	Bluish or grayish-white.
Gonys	The middle line of the lower part of beak.
Gorget	A throat patch of peculiar feathers, such as the red patch on a humming-bird's throat.

Granulate	Roughened with small projections.
Gular	Pertaining to the upper fore neck.
Gular-sack	A pouch or sack on the neck, as in pelicans.
Guttate	With rounded, drop-shaped spots.
Hallux	The great toe; in birds the hind toe.
Heterocercal	A fish's tail when unequal, as in sharks.
Hirsute	Covered with hair.
Homocercal	A tail of a fish when equal on both sides, or when the backbone stops at the middle, as in most fish.
Humerus	The bone of the upper arm.
Hyoid	Pertaining to the tongue.
Hyoid bone	The small bone supporting the tongue.
Hypognathous	Having the lower jaw longer than the upper.
Imbricate	Overlapping like shingles.
Imperforate	Not pierced through.
Inarticulate	Not movable at joints, or not jointed.
Incisors	The front, or cutting, teeth.
Interfemoral membrane	The skin or membrane stretching between the hind legs of a bat.
Jugular	Relating to the throat.
Labials	The scales or plates that form the lips of a serpent.
Lamellæ	Platelike formations inside a duck's bill.
Lamellate	A bill with lamellæ.
Lateral	To or on one side.
Lateral line	A line along the sides of a fish formed by minute tubes.
Lobate	Provided with lobes, or membranous flaps, like the toes of a grebe.
Loral plate	The plate or scale between the eye and mouth of a reptile.
Lore	The space between the eye and the bill.
Mandible	The under jaw; in birds, either jaw.
Maxilla	Upper jaw.
Maxillaries	The outer or hinder bones of the upper jaw in fishes.
Metacarpus	The hand without fingers.
Metatarsus	The foot.
Molars	The rear or grinding teeth in the jaw.
Moniliform	Shaped like a necklace; wide and narrow alternately.
Monogamous	Pairing.
Muciferous	Producing or containing mucus.

Nape	The upper part of the neck next to the head.
Nasal	Relating to the nose.
Neural	Relating to nerves.
Nictitating membrane	The inner eyelid of birds, etc.
Nuchal	Relating to the nape.
Obsolete	Obscure or faint.
Obtuse	Blunt.
Occipital	Relating to the occiput.
Occipital plates	Plates on the occiput.
Occiput	The back of the head.
Ocellate	Eyelike spots.
Ocherous	Brownish-yellow.
Ochraceous	Brownish-yellow.
Opercle or Operculum	The bony covering to the opening in a shell; the gill cover on fishes.
Opercular flap	A prolongation of the operculum in certain fish, as in sunfishes.
Opisthocœlian	Concave behind.
Orbicular	Eye-shaped or nearly round.
Orbit	The eye socket.
Oscine	Musical.
Oviparous	Producing eggs, as in birds.
Palate	The roof of the mouth.
Palatines	Bones of the roof of the mouth.
Palmate	Web-footed; consisting of several rays connected by thin skin or membrane; like a palm.
Papillæ	Small fleshy projections.
Papillose	Covered with papillæ.
Paragnathous	Having both mandibles of equal length.
Pectinate	Comblike.
Pectoral	Relating to the breast.
Pectoral fins	The forward uppermost fins in fishes.
Pelage	The hair or coat of a mammal.
Pelagic	Living on or pertaining to the high seas.
Perforate	Pierced through.
Perissodactylus	Odd-toed (1, 3, or 5 toes).
Peritoneum	The membrane lining the abdominal cavity.
Phalanges	The small bones of fingers or toes.
Pharyngeal bones	Bones in the throat of some fishes.
Plantigrade	Walking on the soles of the feet as bears, coons, and men.
Plastron	The lower shell of a turtle.
Plicate	Folded; showing wrinkles.
Plumbeous	Lead-colored.

Pollex	Thumb; in birds the alula.
Polygamous	Mating with more than one female.
Præcoces	Birds that can feed themselves as soon as hatched, like chickens.
Premolars	The teeth between the eye-teeth and the grinders.
Primaries	The large, stiff quills growing from the first joint or bone of a bird's wing.
Primary wing coverts	The small feathers covering the bases of the primaries.
Projectile	Capable of being thrust out.
Protractile	Capable of being drawn out.
Pulmonary	Relating to lungs.
Punctate	Dotted with small points.
Quadrate	Nearly square.
Quill	The shaft of a feather; the stiff wing or tail feathers.
Quincunx	A set of five arranged with four objects in a square with the fifth in the center.
Radius	The outer bone of the forearm.
Ray	A cartilaginous support for a membrane.
Rectrices	The tail quills of a bird.
Recurved	Turned up.
Remiges	Quills of a bird's wing.
Reticulate	Marked or formed by a network of lines.
Retractile	Capable of being withdrawn.
Retrorse	Pointing backward.
Rictal	Relating to the gape.
Rictus	Gape of the mouth.
Rostral	Pertaining to the snout.
Rudimentary	Undeveloped.
Ruff	A series of feathers or scales around the neck.
Scansorial	Capable of climbing.
Scansorial tail	A tail adapted to climbing, as the woodpecker's.
Scapula	The shoulder-blade.
Scutellate	Provided with scales.
Scutellum	One of the scutellate plates on the legs of birds.
Secondaries	The feathers or quills growing on the forearm, or next to the primaries of birds.
Sectorial	Adapted to cutting.
Semipalmate	Half-webbed.
Septum	A thin partition.
Serrate	Sawlike.
Sessile	Without a stem.
Setaceous	Bristly.

Soft dorsal The rear soft portion of the fin on the back of fishes.

Soft rays Fin-rays that are branching and jointed.

Spine Any sharp, projecting point; in fishes the fin-rays which are not branched or articulate.

Spiniform In the shape of a spine.

Spinous Stiff or made up of spines.

Spiracles Openings in the head or necks of fishes and batrachians, or the breathing-pores in the sides of insects.

Spurious A term applied to the first wing quill in certain birds in which this feather is less than one-third the length of the next.

Sternum The breast-bone.

Striate Streaked or striped.

Suffrago The heel, or tarsal, joint.

Sub-caudal Below the tail.

Sub-aural Beneath the ear.

Sub-orbital Below the eye.

Subulate Awl-shaped.

Superciliary In the region of the eyebrow.

Supra-orbital Above the eye.

Syndactyle Having two toes united for some distance, as in kingfishers.

Synonym A different word having the same meaning.

Synonymous Two words, or terms, that mean the same.

Tail coverts The small feathers covering the bases of the tail feathers.

Tarsus The ankle-bones collectively; in birds, the shank.

Tectrices The wing and tail coverts.

Temporal Pertaining to the temples.

Tenuirostral Slender-billed.

Terete Tapering and cylindrical.

Terminal At the end.

Tertials The quills attached to the wing nearest the body.

Tessellated Marked with checks or squares.

Thoracic Pertaining to the chest.

Thorax The chest; in insects, the portion of the body between the head and the abdomen.

Tibia The shin-bone.

Tomium The cutting-edge of the bill.

Totipalmate Having all four toes connected by webs.

Tragus The inner lobe of the ear.

Trenchant Compressed to a sharp edge.

Truncate	Abruptly ended as if cut off.
Tubercle	A small pimplelike excrescence.
Tympanum	Drum of the ear.
Ulna	The inner bone of the forearm.
Unguiculate	Having claws.
Ungulate	Having hoofs.
Unicolor	Having one color.
Urosteges	The scales, or plates, beneath the tail of reptiles.
Vent	The external opening of the intestine; the anus.
Ventral	Pertaining to the lower side or near the vent.
Ventricle	A part of the heart.
Vertebra	One of the bones of the spinal column.
Vertical plate	The central scale or plate on the head of a reptile.
Villiform	Small teeth in fishes, when slender and crowded into velvety bands.
Viscous	Slimy.
Vitta	A band of color.
Viviparous	Bringing forth living young.
Vomer	The front part of the roof of the mouth.
Zygodactyle	Having toes in pairs, two in front and two behind, as the owls.
Zygoma	The malar or cheek-bone.

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II

GLOSSARY OF BOTANICAL TERMS

Adventive	Not perfectly naturalized.
Alternate	Not opposite, but placed singly, at various distances apart.
Annual	A plant that grows, blossoms, fruits, and dies in one year.
Anther	The part of a stamen containing pollen.
Appressed	Lying flat and close against.
Axil	The angle formed by a leaf and stem.
Basal	Leaves sprouting from the stem at the ground.
Biennial	Plants of two years' duration.
Bilabiate	Having two lips.
Bract	A small specialized leaf usually at the base of the flower stem.
Bulbous	Underground buds with fleshy scales or coverings.
Calyx	The outer "cup" of a flower.
Campanulate	Bell-shaped.
Cleistogamous	Flowers that mature and produce seeds in the bud without opening.
Composite	A flower head made up of many small florets combined in a single "cup," or calyx, as daisies, thistles, etc.
Compound	Composed of several similar parts, or a leaf made up of several small leaflets.
Cordate	Heart-shaped, with point outward.
Corm	The enlarged, solid, bulbous base of the stem.
Corolla	The inner part of a flower, usually composed of petals.
Corymb	A flat-topped cluster of flowers.
Cross-fertilization	The crossing of two kinds of plants caused by the pollen of one flower coming in contact with the stigma of another.

Creeping	A stem that runs along the ground and roots at intervals.
Dentate	Toothed.
Disk flowers	Tubular florets found in the center of composite flowers.
Entire	Smooth edges; without teeth or divisions.
Evergreen	Bearing green leaves at all seasons.
Fertile	Capable of producing seeds or fruit.
Filament	The threadlike part of a stamen.
Floret	A small tubular flower.
Glabrous	Smooth; not hairy or rough.
Glaucous	Covered with a whitish bloom.
Hirsute	Covered with hairs.
Imperfect	Flowers with stamens or pistil wanting.
Introduced	Brought purposely from other localities.
Involucre	A cup-shaped cluster of bracts surrounding a flower.
Irregular	Parts unequal in shape or size.
Lanceolate	Lance-shaped; longer than wide, pointed at the tip and tapering at the base.
Leaflet	A single division of a compound leaf.
Linear	Long and narrow, with edges or margins parallel.
Lip	Either part of a two-parted corolla; the broad specialized petal of an orchid.
Lobe	A rounded division of a leaf or flower.
Midrib	The large, central rib of a leaf.
Naturalized	Plants that are not native, but have become firmly established.
Nerve	A single unbranched rib or vein.
Ovate	Egg-shaped.
Palate	A rounded projection of the lower lip which closes the throat.
Palmate	Spreading like a hand.
Parasitic	Plants that live by obtaining their nourishment from other plants.
Pedicel	The stem of a single flower.
Peduncle	A flower stalk supporting a flower or a cluster of flowers.
Perennial	A plant that lives year after year.
Perfect flower	Flowers having both stamens and pistil.
Perfoliate	A leaf pierced by the stem.
Perianth	The calyx and corolla of a flower.
Petal	A single division of the corolla.
Petiole	The stem of a leaf.

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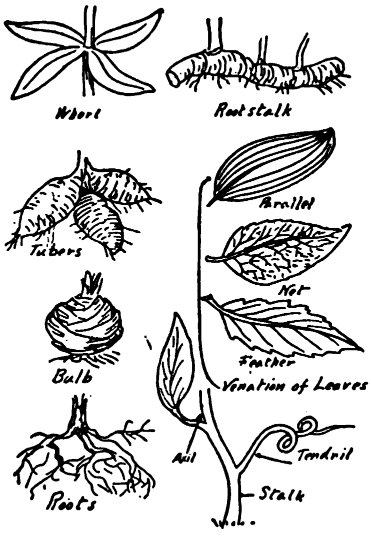
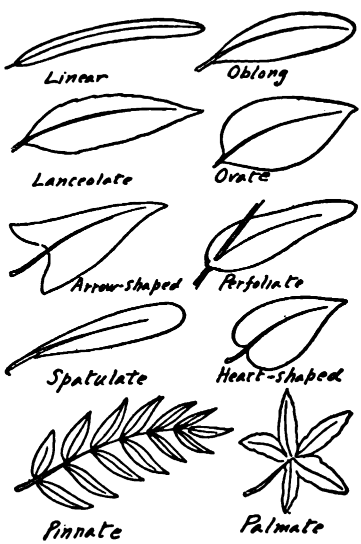
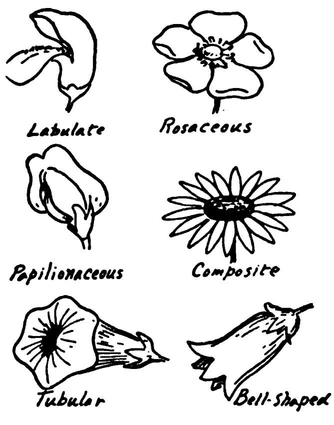


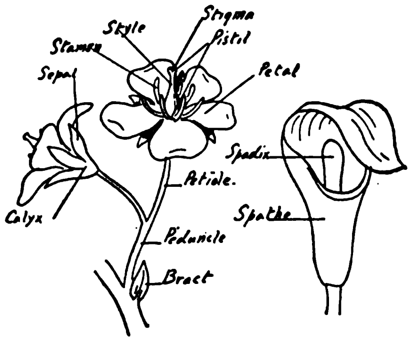
PARTS OF PLANT



SHAPES OF LEAVES



FORMS OF FLOWERS



PARTS OF FLOWER

Pinnate	Composed of numerous leaflets arranged along the sides of a single petiole or stem.
Pistil	The ovary or seed-producing organ, stigma, and style of a flower.
Pistillate	Flowers having pistils but no stamens.
Pollen	The dusts or grains on the stamens.
Raceme	Pediceled flowers that grow along a more or less elongated flower stem.
Radiate	Projecting from or around a common center.
Ray	The marginal flowers around a disk.
Rib	A prominent vein of a leaf.
Root	The parts of a plant underground.
Scape	A leafless stem rising from the earth and bearing flowers.
Sepal	A division of the calyx.
Serrate	Having sharp teeth along the edge.
Sessile	Without a root, stalk, pedicel, or petiole.
Simple	Not compound or branched.
Spadix	A fleshy thickened spike, usually in a spathe.
Spathe	A large bract or cup inclosing flowers.
Spatulate	Rounded at the end and narrowing toward the base.
Spike	Sessile flowers on a long stem, usually forming a compact, tapering group.
Spur	A hollow extension of some part of a flower usually containing nectar.
Stamen	The organ that bears the pollen.
Standard	The upper opened portion or petal of a pea-like flower.
Stem	The principal stalk of a plant.
Sterile	Flowers that do not produce seeds or fruit.
Stigma	The part of the pistil through which the pollen enters.
Stipsule	An appendage or bract at the base of the stem of a leaf.
Style	The connecting stalk or tube between the stigma and ovary.
Tuber	A thickened underground root with buds or "eyes."
Tufted	Growing in clusters.
Umbel	A cluster of flowers with the stems all coming from a common center.
Veins	Threadlike branching nerves or ribs.
Whorl	The arrangement in circular form around a stem.

III

TERMS APPLIED EXCLUSIVELY TO INSECTS

Alula	A membrane beneath the fore wing, as in house-flies.
Alulet	The same as alula.
Ambient vein	A vein that extends entirely around the wing.
Anal angle	The angle between the inner and the outer margin of a wing.
Anal veins	Veins of the anal angle of the wing.
Antecoxal piece	A small plate near the base of the rear legs found in certain beetles.
Antennæ	Jointed appendages on the front of the head.
Aorta	The prolongation of the heart extending through the thorax.
Apex	The extreme outer angle of the wing.
Axillary excision	A notch in the inner margin of the wing near its base.
Beetles	Insects having horny veinless wing-covers meeting in a straight line down the back and undergoing a complete metamorphosis.
Bugs	Insects having mouth parts adapted for piercing or sucking, and which do not undergo a complete metamorphosis.
Calamistrum	Curved spines on the hind legs of certain spiders.
Capitate	Having a head; particularly applied to antennæ in which the terminal joint is enlarged.
Caudal setæ	Jointed filaments on the end of the body.
Cell	The part of a wing inclosed by veins; the openings or chambers of a honeycomb or nest.
Cerci	Filaments on the body.
Chitine	A horny substance of which the skins and hard parts of insects are largely composed.

Chrysalis	The pupa of an insect; the intermediate stage between the larva and adult; particularly, the pupa of a butterfly.
Claspers	Curved organs on the abdomen of insects.
Clavate	Club-shaped; applied particularly to the form of antennæ.
Clavus	A thick, basal portion of the wing in certain bugs.
Closed	A form of the cavities in the thorax of beetles.
Clubionids	A group of spiders.

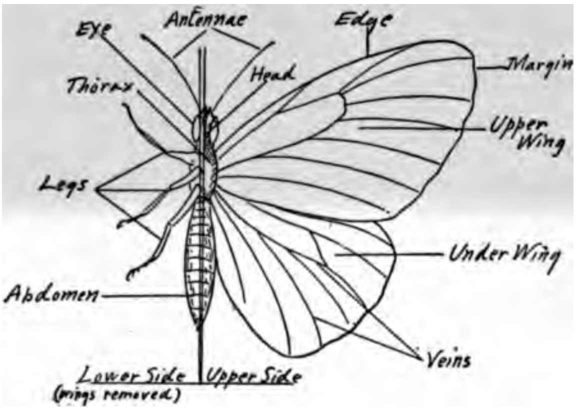


Fig. 1

PARTS OF A BUTTERFLY

Cocoon	The silken covering of a chrysalis or pupa; the silken mass within which spiders' eggs are placed.
Coleoptera	The group of insects commonly known as beetles.
Complete metamorphosis	The metamorphosis or change from the egg to adult, in which larval, pupate, and imago stages are distinct, as in butterflies and moths.
Compound eyes	Eyes made up of a large number of small lenses or eyes joined together in a single mass.
Corium	A part of the thicker portion of the wing in certain bugs.
Cornicles	Tubes on the abdomen of certain insects through

[redacted]

which a substance known as honey-dew is excreted.

Costa One of the principal veins of the wing lying nearest the margin.

Costal margin The margin of the wing nearest the costa.

Coxa The joint of the leg nearest the body.

Coxal cavities The openings in the lower side of thorax in which the legs are inserted.

Cribellum An organ for spinning web on the lower side of the abdomen of a spider.

Cubitus The fifth vein of a wing, counting from the costal margin.

Diptera A group of insects commonly known as flies, and distinguished from wasps, bees, etc., by having but two wings.

Discal cell A large cell near the base of the wings in certain insects, notably in butterflies.

Discal vein The transverse vein at the outer end of the discal cell.

Elytra The horny outer wings or wing covers of beetles.

Embolium A portion of the thick basal portion of the wing in certain bugs.

Epimerum A portion of the thorax of beetles.

Episternum A portion of the thoracic structure of beetles.

Femur The third joint of the leg from the body.

Filiform Threadlike; applied to slender antennæ with all the joints of about equal size and slender.

Flabellate A form of antennæ with long, toothlike processes; fanlike.

Frenulum A bunch of bristles or a spine on the inner forward edge of the hind wings of some moths.

Galea The outer lobe of the mouth parts of certain insects.

Ganglion A nerve-center similar to a brain.

Geniculate A form of antennæ bent sharply at the first outer joint, or elbow-shaped.

Glossa A portion of the mouth parts of beetles.

Grub The larval form of beetles and other insects.

Gula The lower central portion of the head of a beetle and the part that bears the mouth.

Gular sutures The joints that bound the gula.

Head The forward segment or portion of an insect's body; the part that bears the mouth, antennæ, and eyes.

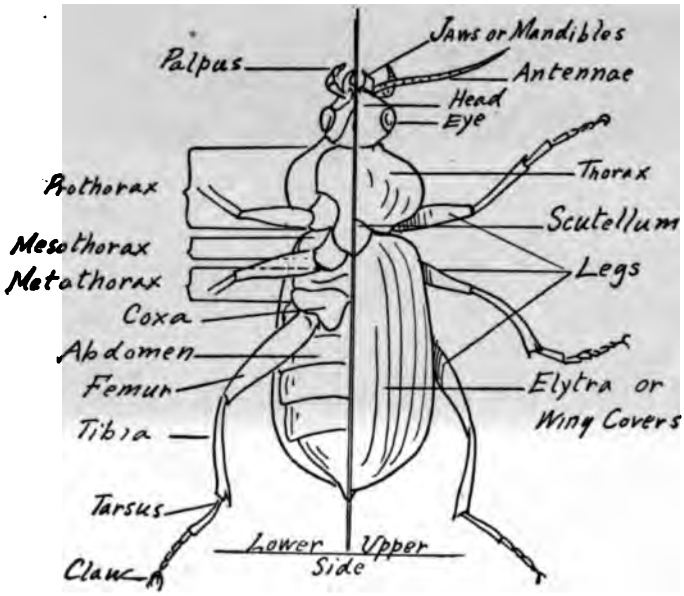


Fig. 2

PARTS OF A BEETLE

Hemiptera	An order of insects including the bugs.
Hexapoda	A class of the animal kingdom commonly known as insects.
Homoptera	A suborder of the bugs.
Humeral angle	The angle of the wing between the costal and outer margins.
Humeral veins	The veins that bound the humeral angle.
Hymenoptera	The order of insects that includes bees, wasps, ants, etc.
Hypopharynx	A tonguelike organ within the mouth.
Incomplete metamorphosis	The metamorphosis or growth of an insect in which the larval, pupal, and adult stages are not distinct, or in which any two are not distinct.
Inner margin	The inner edge of the wing.

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Labial palpi	Small leglike organs at the sides of the mouth.
Labium	The lip or liplike parts of the mouth.
Larva	The stage of insects that resembles a worm or grub; the first stage after emerging from the egg.
Lepidoptera	An order of insects usually known as moths and butterflies.
Locusts	A group of insects belonging to the grasshopper family; incorrectly applied to the cicadas or harvest-flies.
Mandibles	The jaws or hard cutting or biting parts of the mouth.
Marginal cells	Cells of the wings next to the margin.
Maxillæ	Parts of the mouth just behind the mandibles.
Maxillary palpi	Handlike organs close to the maxillæ.
Media	The fourth vein of the wing from the costal margin.
Mentum	A part of the labium.
Mesonotum	A segment of the thorax in beetles.
Mesosternum	A part of the thoracic structure of beetles.
Mesothorax	The second thoracic segment.

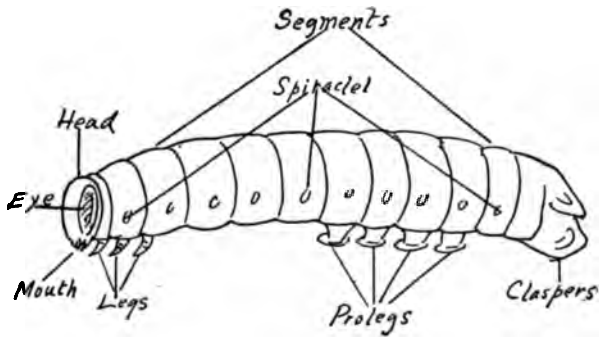

Fig. 3

PARTS OF A CATERPILLAR

Metamorphosis	The changes of an insect from egg to adult.
Metanotum	A portion of the thoracic structure.
Metasternum	Another part of the thoracic segments of beetles.
Metatarsus	The sixth joint of the leg from the body.

Metathorax	The third joint or segment of the thorax.
Molting	The act of changing the skin in insects.
Moths	Lepidiptera in which the wings are not held vertically above the body when at rest, but are folded along the back, or spread horizontally.
Myriopoda	A group of animals related to the insects, but with numerous legs, such as the centipedes and millipedes commonly known as "thousand-legs."
Neuroptera	Four-winged insects with mouth parts adapted for biting, and undergoing a complete metamorphosis; the ant-lions, aphis-lions, dobsons, etc.
Nympth	The younger stages of insects which do not undergo a complete metamorphosis; applied to all the stages from eggs to adult in such insects.
Ocelli	Simple eyes as distinguished from compound eyes. Eyelike color spots or markings.
Odonata	The order of insects including the dragon-flies.
Orthoptera	An order of insects which includes the crickets, roaches, grasshoppers, mantis, etc.
Ovipositor	An organ projecting from the abdomen used in depositing the eggs.
Palpi / **Palpus**	Feelers beside the mouth.
Patella	The fourth portion or segment of the leg.
Pectinate	Comblike; applied to antennæ with toothlike processes on the sides.
Plecoptera	The order of insects including the stone-flies.
Plectoptera	An order of insects including the May-flies.
Prolegs	Fleshy legs on the rear portion of certafn larvæ, as in caterpillars.
Prothorax	The first section of the thorax nearest the head.
Pulvilli	Cushions or pads of hair on the legs or feet that enable insects to walk on the lower surfaces of objects.
Pulvullus	Plates on the feet that serve the same purpose as pulvilli.
Pupa	The stage in the transformation of insects between the larval and adult stage; the chrysalis.
Sclerite	The hardened ringlike part of a body segment.

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GLOSSARIES OF SCIENTIFIC TERMS

Scutellum	A part of the thorax which appears as a triangular piece between the bases of the wing-covers and thorax in beetles.
Setaceous	Bristlelike; applied to a form of antennæ in which the segments taper gradually to a point.
Simple eyes	Eyes placed singly with a single lens.
Spinnarets	Organs on spiders used in spinning silk.
Spiracles	The external openings of the breathing-organs.
Stemmata	A term applied to single eyes.
Sternum	The ventral portion of the thorax.
Subcosta	The second vein of the wing from the costal margin.
Sutures	The depressed lines or joints between segments.
Tarsus	The last outer segment of the legs.
Thorax	The second part of the body between the head and abdomen.
Tibia	The fifth joint of the leg.
Tracheæ	Gill-like organs for breathing.
Trichoptera	An order that includes the caddis-flies.
Under wings	The rear or second wings of insects, the forward edges of which rest beneath the forward wings.
Upper wings	The forward wings, in which the rear edges rest above the hind wings.

Appendix II

CLASSIFICATION OF ANIMALS

I

CLASSIFICATION OF VARIOUS GROUPS

THE classification of any group of animals is an easy matter once we understand the system, but to divide up any group into the various orders, classes, families, genera, species, and varieties requires a special paper for each group and savors strongly of a scientific or technical work, and is scarcely essential for young naturalists who wish to get a general idea of all animals and do not intend to make a special study of one branch.

It is at times, however, quite necessary to know something about just where a certain specimen belongs in its branch or class of the animal kingdom; and, although nearly any boy can distinguish the various classes as mammals, birds, reptiles, insects, etc., but comparatively few can tell whether a certain bird or insect belongs in the same order with some other specimen or not, unless familiar with the families or species that belong to the order. For the help of young collectors who may wish to group their collections by orders, or may desire to look up specimens in scientific works, the following outlines of the classification of various groups of animals by orders is given. These are not in-

tended as examples of complete classification, and only those species or families are mentioned, as belonging to a given order, that are common and typical examples.

Among the marine invertebrates even the orders are so numerous and so difficult to describe in anything but a strictly technical work that only the principal branches with their various classes are given, with a few common names of the more typical animals belonging in each class. Many of the branches and classes have been purposely omitted, as they are small microscopic or very obscure creatures not liable to be collected, and of no value for a boy's museum, and the youthful naturalist who wishes to learn of these minute and difficult forms of marine life should consult a standard text-book on the subject.

The same holds true of the boy who wishes to make more than a superficial study of botany, while the fishes are divided and classified by such obscure or strictly anatomical differences that an attempt to give a general or rough synopsis of their orders or families would be impossible or at least impractical in a book of this scope or character.

CLASSIFICATION OF MARINE INVERTEBRATES

BRANCH	CLASS	SPECIES, ETC.
Porifera	....	The sponges.
Cœlenterata	....	The hydroids; sea-anemones; jellyfish and corals.
....	Hydrozoa	Hydroids and elk-horn coral. Portuguese man-o'-war.
....	Scyphozoa	True jellyfishes.
....	Actinozoa	Sea-anemones and stony corals.
....	Alcyonaria	Sea-fans; red coral; sea-pens, etc.
Vermes	....	The smooth worms.
....	Planaria	Flat worms, or planarians.
Molluscoida	....	The polyzoans.
....	Polyzoa	Bryozoa.
....	Brachipoda	"Lamp-shells," or brachipods.
Echinodermata	....	The echinoderms.
....	Asteroidea	Starfishes.
....	Ophiuroidea	Serpent-starfish; basket-starfish.
....	Echinoidea	Sea-urchins; sand-dollars.
....	Holothuroidea	Sea-cucumbers; sea-puddings, etc.
....	Crinoidea	The sea-lilies, or crinoids.
Annulata	....	Marine worms.
....	Chætopoda	Marine worms; jointed worms; sand-worms.
Arthropoda	....	The crustaceans.
....	Crustacea	Crabs; lobsters; prawns; shrimp; barnacles; sow-bugs.
Mollusca	....	The mollusks.
....	Pelecypoda	Bivalve shells, such as oysters, clams, mussels, etc.
....	Amphineura	Chitons and mollusks with an eight-piece shell, or naked.
....	Gastropoda	Mollusks with a single shell, or naked, such as winkles. Snails, whelks, limpits, naked mollusks.
....	Cephalopoda	Mollusks with numerous arms or tentacles, such as squids, cuttlefish, octopus, nautilus, etc.
Chordata	....	Ascidians.
....	Urochorda	Tunicates; ascidians; salpa.

II

CLASSIFICATION OF INSECTS BY ORDERS

Thysanura — Wingless insects which undergo no metamorphosis, the larval form being retained throughout life. Wingless. This order includes the *bristle-tails*, *spring-tails*, etc.

Ephemerida — Insects with delicate membranous wings and which do not undergo a complete metamorphosis. *May-flies*, etc.

Odonata — Insects with four membranous wings, mouth parts for biting. Metamorphosis incomplete. *Dragon-flies.*

Plecoptera — Insects with four membranous wings, the hind wings larger than the fore wings. Mouth parts adapted for biting. Metamorphosis incomplete. *Stone-flies.*

Isoptera — Social insects with winged kings and queens with long narrow wings, leathery in structure. Mouth parts for biting. Metamorphosis incomplete. *Termites*, or *white ants.*

Corrodentia — Insects with four membranous wings, with few veins. Fore wings larger than hind wings. Wings carried in a roof-like position over the back. Mouth parts for biting. Metamorphosis incomplete. *Book-lice*, etc.

Mallaophaga — Wingless, parasitic insects with biting mouth parts. Incomplete metamorphosis. *Bird-lice.*

Euplexoptera — Four-winged insects with the first pair leathery, very small, without veins. Second pair of wings large, with veins, and folded lengthwise and crosswise when at rest. Mouth parts for biting. Rear end of body with pincerlike organs. Metamorphosis incomplete. *Earwigs.*

Orthoptera — Four-winged insects with the first pair thick and overlapping the others when at rest. Lower wings

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folded like a fan when at rest. Mouth parts for biting. Incomplete metamorphosis. *Crickets*, *grasshoppers*, *roaches*, *mantis*, *katydid*, *walking-sticks*, etc.

Physopoda — Four-winged insects with the wings long, narrow, membranous, not folded, and with few veins. Wings fringed with hairs and laid horizontally on the back when at rest. Mouth parts intermediate between biting and sucking organs. The metamorphosis is incomplete. *Thrips*.

Hemiptera — Four-winged insects. Mouth parts formed for sucking. Metamorphosis incomplete. *Bugs*, *lice*, *aphids*, *cicada*, *scale-insects*, *etc.*

Neuroptera — Insects with four wings of membranous structure and numerous veins. Mouth parts for biting. Complete metamorphosis. *Ant-lions*, *aphis-lions*, *dobsons*, etc.

Mecoptera — Insects with four wings, membranous and many-veined. Head prolonged into a biting beak. Complete metamorphosis. *Scorpion-flies*, *snow-insects*.

Trichoptera — Four-winged insects with membranous wings more or less covered with hairs. Mouth parts rudimentary. Complete metamorphosis. *Caddis-flies*.

Lepidoptera — Four-winged insects that have membranous wings thickly covered with overlapping scales. Mouth parts for sucking. Metamorphosis complete. *Moths*, *butterflies*, *skippers*.

Diptera — Insects with but *two* wings with knobbed threads behind them. Mouth parts formed for sucking. Complete metamorphosis. *Flies*.

Siphonaptera — Wingless insects with mouth parts adapted for sucking. The metamorphosis is incomplete. *Fleas*.

Coleoptera — Insects in which the wings are protected by horny wing-covers which meet in a straight line down the back. Wings membranous and two in number. Mouth parts formed for biting. Complete metamorphosis. *Beetles*.

Hymenoptera — Insects with four membranous wings (some species wingless in certain forms or sexes). Hind wings smaller than front wings. Mouth parts for both biting and sucking. Abdomen of females generally provided with a sting, piercer, or sawlike organ. Complete metamorphosis. *Bees*, *wasps*, *ichneumon-flies*, *gall-flies*, *ants*, *etc.*

III

CLASSIFICATION OF ANIMALS RELATED TO INSECTS

Order	*Class Arachnida*
Scorpionida	Abdomen jointed, with a terminal sting. *Scorpions.*
Solpugida	Head distinct from thorax. Mandibles with strong pincers. Two eyes. *Jointed spiders.*
Pseudoscorpiones	Abdomen without appendage at end. Palpi with pincer-like claws. *Pseudo scorpions.*
Pedipalpi	Abdomen joined to thorax by a slender stem. Front legs elongated and whiplike. No pincerlike palpi. *Whip-scorpions.*
Phalangidea	Legs long and slender. Thorax not divided into distinct segments. *Daddy-long-legs*, or *harvestmen.*
Araneida	Abdomen joined to thorax by a short stalk. Abdomen without segments. Abdomen with organs for spinning silk. *Spiders.*
Acarina	Abdomen joined with thorax in one piece. *Mites.*
	Class Myriapoda
Chilopoda	Head distinct from thorax, and thorax and abdomen forming one continuous segmented body with from six to very numerous joints, each segment bearing a pair of legs. Body usually flattened. Head with a single pair of antennæ. *Centipedes.*
Chilognata	Body usually rounded, each segment except the first three bearing two pairs of legs. Antennæ short. *Millipedes.*

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IV

ORDERS OF MAMMALS

Montremata	Animals peculiar to Oceanica. *Duck-bills* and *echidnas.*
Marsupialia	Animals provided with a pouchlike pocket or fold of skin in which to carry the young. *Opossums, kangaroos,* and all mammals native of Australia.
Edentata	Curious animals specialized for peculiar methods of life or feeding. Often armed with spines or covered with armor. *Ant-eaters, sloths, armadillos.*
Rodentia	Animals with teeth adapted to gnawing. *Rats, mice, squirrels, rabbits, beavers, porcupines, marmots,* etc.
Insectivora	Animals that feed upon insects. *Moles, shrews, hedgehogs.*
Chiroptera	Animals provided with membranous wings or skin stretched between the fingers and limbs. *Bats.*
Cetacea	Mammals adapted for marine life and lacking true limbs, these organs being replaced by flippers, or paddles. *Whales, porpoises,* etc.
Sirenia	Mammals adapted for life in the water, but capable of crawling on land at times. Not covered with hair or fur, and feeding on vegetable substances. *Manatees, dugongs.*
Proboscidia	Mammals feeding on vegetable substances and with the nose prolonged into a proboscis. *Elephants.*
Hyracoidea	Small animals with hooflike toes and rodentlike habits confined to Asia and Africa. *Hyrax* or *daman.*
Ungulata	Herbivorous mammals with one or more horny toes or hoofs on each foot. *Rhinoceros, tapir, deer, horse, ass, swine, hippopotamus,* and all horned animals.
Carnivora	Mammals that feed wholly or partly on flesh. *Bears, cats, dogs, seals, weasels, wolves, hyenas,* etc.
Primates	The highest order of mammals in which the fore foot is developed into a clasping or handlike organ, or hand. Many species can walk upright on the hind legs. *Monkeys, lemurs, man.*

V

ORDERS OF BIRDS

Pygopodes (diving-birds)	Wings weak. Tail small. Feet webbed; near rear end of body. *Loons, grebes, auks, puffins.*
Longipennes (long-winged swimmers)	Toes clawlike; wings long; legs weak; bills sharp, pointed, or hooked; feet webbed. *Skuas, gulls, terns,* etc.
Tubinares (tube-nosed swimmers)	Feet webbed; legs weak; wings long; nostrils in the form of tubes on the bill. *Fulmars, petrels, albatross.*
Steganopodes (totipalmate swimmers)	Toes all joined by a web; wings long; toes with claw; bills strong; a pouch, or sack, beneath bill or in throat. *Pelicans, gannets, man-o'-war birds, tropic birds, cormorants, snake-birds,* etc.
Anseres (ducks, geese, etc.)	Feet webbed; plumage dense; wings narrow. *Ducks, geese, swans,* etc.
Odontoglossæ	*Flamingoes.*
Herodiones (wading-birds, etc.)	Legs long; plumage loose or soft; necks long and slender. *Herons, ibis, egrets, boat-bills, spoon-bills,* etc.
Paludicolæ (marsh-birds)	Hind toe higher than others; legs long. *Cranes, rails, limpkins,* etc.
Limicolæ (shore-birds)	Legs long and slender; bills slender. *Snipe, sand-pipers, plover, avocets, stilts, curlews, phalaropes, jacanas,* etc.
Gallinæ (scratching-birds)	Wings short and rounded; confined usually to or near the earth; bill strong and short; feet large and strong, not webbed. *Turkeys, partridges, grouse, quail, pheasants.*
Columbæ (pigeons)	Bills slender, hard at tip; legs small and wings long. *Pigeons, doves.*
Raptores (birds of prey)	Bill and claws usually hooked and strong; wings powerful and large; feet and legs strong. *Eagles, vultures, hawks, owls.*

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Psittaci (parrots)	Feet and legs strong; claws hooked, bill strong and hooked. *Parrots, macaws, cockatoos.*
Coccyges (cuckoos, etc.)	Toes two in front and two behind; legs usually weak; bills strong and sharp. *Cuckoos, road-runners, trogans, kingfishers.*
Pici (the woodpeckers)	Feathers close and soft; feet strong with hooked claws; bills very strong, chisel-shaped; tails usually with sharp points to the feathers. *Woodpeckers, flickers.*
Macrochires (the swifts, etc.)	Wings long or slender; feet very weak and small; bills either small and weak or long and delicate. *Night-hawks, whippoorwills, chimney-swifts, humming-birds,* etc.
Passeres (perching-birds)	This order includes all the land birds not included in the other orders, such as *tanagers, flycatchers, crows, jays, orioles, blackbirds, thrushes, swallows, finches, sparrows, shrikes, vireos, warblers, wrens, kinglets, nuthatches,* etc.

VI

ORDERS OF REPTILES

Testudinata	No teeth; body with more or less bony shells, or plates. *Turtles* and *tortoises*.
Lacertilia	Jaws with teeth; body covered with scales; four legs. *Lizards*, *iguanas*, *swifts*.
Ophidia	Jaws with teeth; body covered with scales; no feet or legs. *Serpents* and *snakes*.

VII

ORDERS OF BATRACHIANS

Anura	Body without tail in adult. Four legs, the rear legs being much the larger and more developed. No scales on body. *Frogs* and *toads*.
Urodela	Body lengthened and with a distinct tail. Body without scales, and all four legs nearly equal in length. *Newts*, *salamanders*.
Proteida	Body long, with a distinct tail. No scales on body. External gills on neck throughout life. No eyelids. *Mud-puppies*, *sirens*, *water-dogs*.

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THE END

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